NEW YORK SEATTLE

MOTORSHIP

Devoted to Commercial and Naval Motor Vessels

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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

MOTORSHIP

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PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

Vol. VII New York, U. S. A., November, 1922 No. 11

(Cable Address—Freemote, New York)

American Motorship's 20,000 Miles Maiden Voyage

Splendid Performance Recorded by United American Line's Diesel-Driven Freighter "Californian," Tho' Hampered by Bent Propeller Blade—Total Fuel-Bill Only $11,227.78

EXCEPT for some very minor and almost trifling adjustments to some springs used for closing the exhaust valves, and to several piston rings, the twin 2,250 i.h.p. Diesel engines of the new American motorship CALIFORNIAN both made non-stop runs while driving the vessel on her maiden voyage of 20,232 nautical-miles round the coast of the U. S. A., over to Europe and back to New York, thus fully justifying the confidence displayed by her owners, the American-Hawaiian Steamship Company. On this long trip only just over one thousand tons of oil fuel (7,151 barrels to be exact) were burned at sea, and seventy-eight tons of oil fuel were consumed while running all the Diesel-electric auxiliaries when loading and discharging cargo in seventeen ports. Taking into consideration that this ship has a total cargo cubic-capacity of 650,379 feet and that although hampered by a bent propeller blade for thirteen thousand miles of the voyage, she averaged nearly twelve knots for the entire trip, other domestic shipowners will realize she is a craft worth very considerably more in first cost than a steamer of similar overall dimensions, although only costing about 12 per cent more. And that she is doing the work of a steamer very much greater in both power and dimensions, factors which hitherto have been given far too little consideration. As indicated by her operation with the propellers in O. K. condition she undoubtedly will average 11½ to 12 knots fully loaded over the annual operation.

Shipowners must awake to the fact that they are only deceiving themselves when they figure on the comparative costs of steamships and motorships of similar dimensions and horse-power. They must become firmly impressed with the knowledge that a smaller and lower powered Diesel ship is equivalent to a bigger and higher-powered turbine or reciprocating engined steamer. Giving a 10 per cent difference in dimensions and power, both ships will carry the same quantity of cargoes at the same average speed, with an additional gain to the smaller motorship inasmuch as her port consumptions will be very much lower. This makes a noteworthy difference in the first cost even if Diesel machinery is more expensive. In fact, it makes a motorship no more costly than a steamer to build.

> The American-Hawaiian Steamship Company has shown the way. The results of their leadership are outlined on these pages, which every shipowner should read.

As the fuel burned by the CALIFORNIAN cost her owners $1.57 per 42-gallon barrel, the total fuel bill amounted to $11,227.07 at sea and $533.80 in port, or a grand total of $11,760.87 over a five months' period lasting from the early part of May to the end of September. Except for the cost of dry-docking to straighten the propeller blade bent by a submerged log in the Columbia river, there was no repair or replacement bill worth mentioning. The lubricating oil consumption for all purposes, including deck and auxiliary machinery, amounted to 16 gallons per day. The total wage bill for the crew of 37 deck officers, engineer-officers and men amounts to $3,248 per month. The fuel oil used was of 23.5 degrees gravity, 0.913 specific gravity, with 0.60 per cent sulphur and 1.11 per cent asphalt.

Possibly these statements regarding the performance of the CALIFORNIAN will be received incredulously by some shipping men and will be regarded as distorted and exaggerated by biased interests. To such we can answer that the figures given in the table were copied directly from the ship's log through the courtesy of the United American Lines, who operate the CALIFORNIAN for her owners. Furthermore, since setting in type the data has been checked by officials of the company.

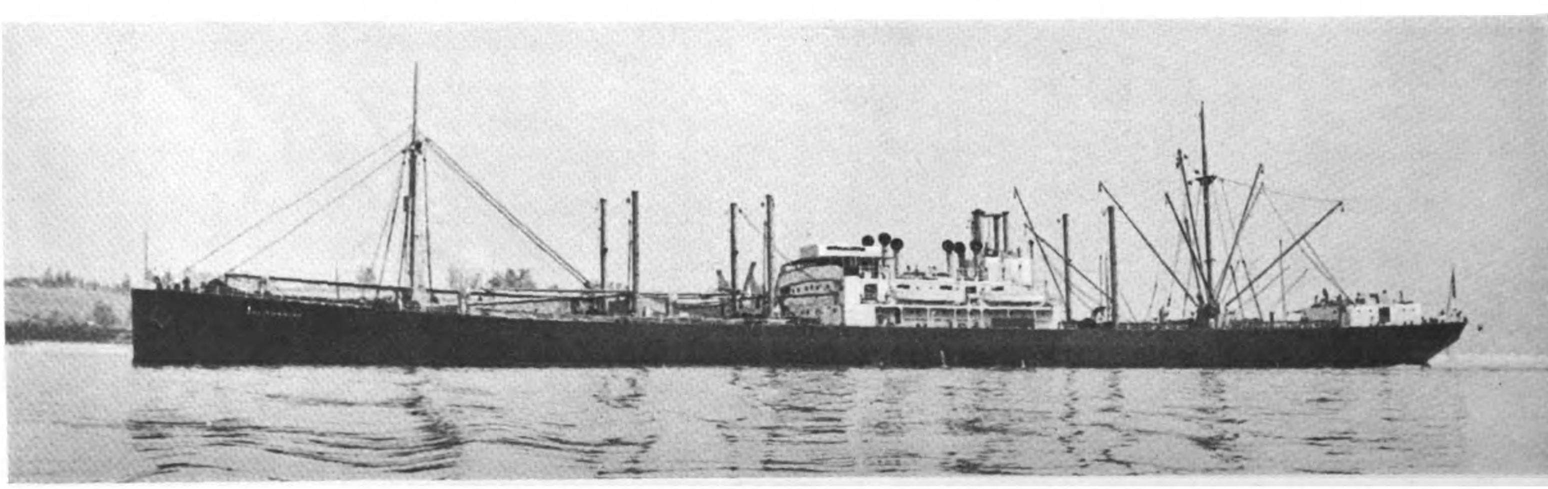
For the benefit of boilermakers and other anti-Dieselites we draw special attention to the horse-power hour fuel consumption, which has averaged three-tenths of a pound per indicated horse-power hour, and at times twenty-eight hundredths of a pound, compared with a fraction under a pound of oil for the very best geared-turbine practice, and over one pound for general average. Prominent naval architects and engineers have maintained that the fuel consumptions of motorships for all purposes run as high as six-tenths pound per shaft horsepower hour, but have never produced a single authentic record. Nor have we seen such.

Rapid handling of freight has been greatly facilitated by her Westinghouse-A. E. C. electrical deck machinery. All the winches have Westinghouse watertight motors of 30 b.h.p at 400 R.P.M. Fourteen winches were built by the American Engineering Co. and two by the Shepard Crane Co. The entire deck equipment has shown itself to be far superior to steam machinery in handling and in economy.

The CALIFORNIAN was fully described and illustrated in our issue of June last, and her leading dimensions are as follows:

CAPACITY

Loaded displacement at 28'6" dft.	16,500	tons
Light displacement	5,300	tons
Net cargo-capacity on long-distance voyage (not including fuel, etc.)	9,585	tons



American-Hawaiian Steamship Co's. motorship "Californian" loaded deep with cargo which she delivers at a cost no similar steamer can equal

Underdeck cargo-capacity (grain).......598,492 cu. ft.
Capacity of deep tanks & hatches....... 50,610 cu. ft.
Refrigerated space.......................1,277 cu. ft.

Total Cubic Cargo-Capacity.......650,379 cu. ft.

Fuel-capacity (in double bottoms, settling-tank, and supply tanks)............... 1,368 tons
Fresh-water capacity.................... 208 tons

DIMENSIONS

Length O. A..............................461'7½"
Length B. P.............................. 445'0"
Breadth M. D.............................. 59'8"
Depth (Moulded to S. D.).................. 39'0"
Draught, loaded............................ 28'6"
Block Coefficient.......................... 0.76
Midsection Coefficient 0.986

POWER

Twin six-cylinder 29⅛"x45¼" at 115 R. P. M...................2,250 I. H. P. each
Four auxiliary Diesel-electric-sets of 65 K. W...................75 to 100 b. h. p. each

SPEEDS AND CONSUMPTIONS

Designed speed........................11¾% knots
Loaded Speed (actual)............11¼ to 12⅛ knots
Speed (light)............................ 14 knots
Fuel-Consumption per I. H. P. hour..........0.30 lb.
Fuel-consumption per 24 hours (all purposes at sea)................................14¼ tons
Consumption in Port.......................¾ ton

WEIGHTS

Weight of two main engines together......545 tons
Complete weight of machinery, including generators auxiliary Diesels, tanks, etc.....930 tons
Weight of hull and machinery............5,300 tons
Length of machinery space (incl. thrust recess)....................................60'8"

She was built at the Merchants Shipyard, Chester, Pa., and equipped with Burmeister and Wain type Diesel-engines constructed and installed by the Wm. Cramp & Sons Ship and Engine Co., Philadelphia, Pa. Her electrical deck-machinery was mostly manufactured by the American Engineering and Westinghouse companies, with Diehl electric generators and motors in the engine-room. This deck machinery has given splendid service when handling cargo at the numerous ports of call, and being faster in operation than the deck machinery of most European motorships is therefore more efficient. Her best speed over a 24-hour period with the ship partly loaded has been 14.07 knots.

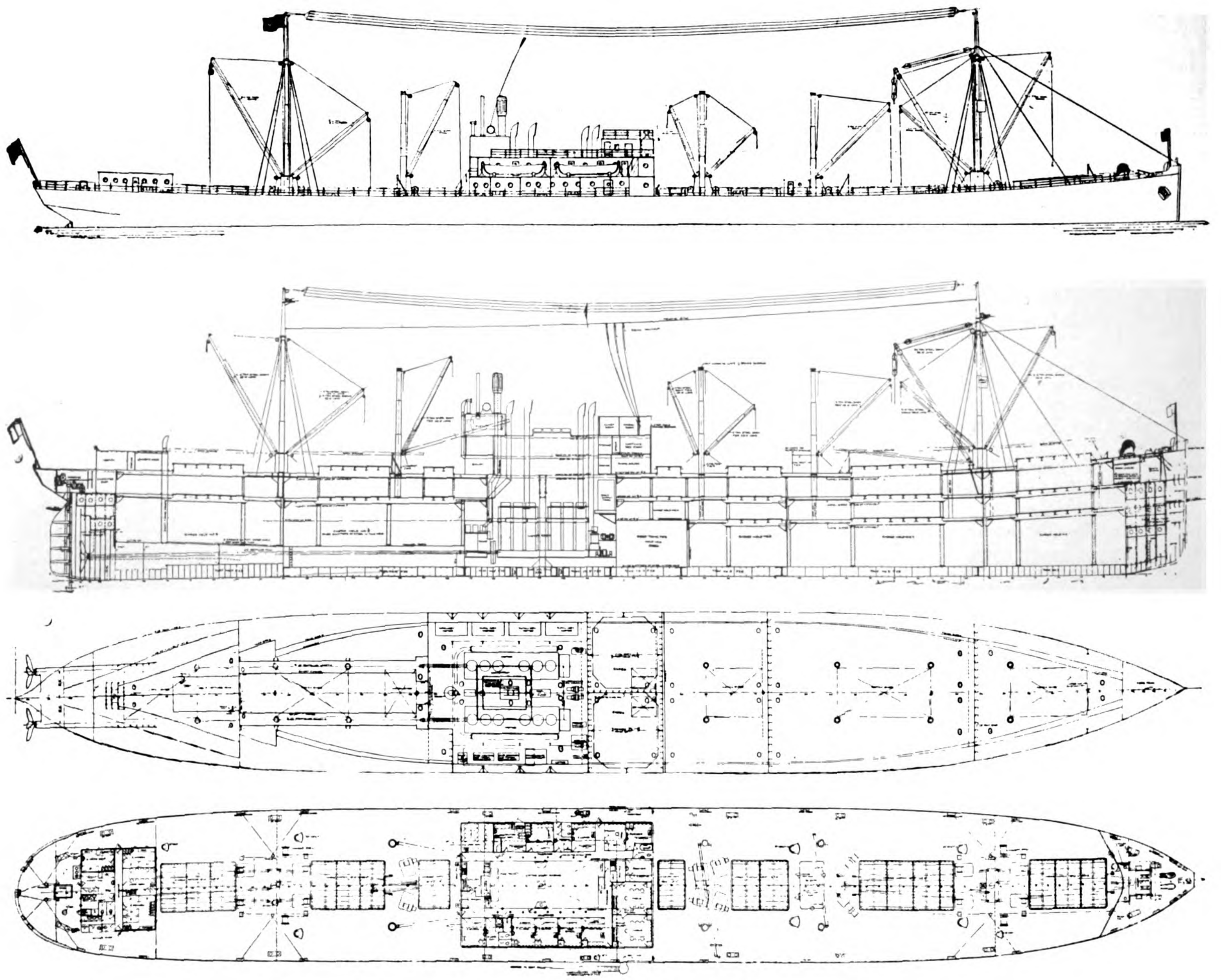
Compared with steamships the capacity, speed and performance of the CALIFORNIAN is really remarkable, but it will be equaled and even bettered by American motorships in the

Maiden Voyage of the Motorship "Californian"

Route	*Distance by Observation (Nautical Miles)*	*Engine (Revs. per Minute)*	*Propeller-Slip*	*Ship's Speed*	*Consumption (Barrels per day)*	*Lbs. per I.h.p. Hour*
Philadelphia to New York............	240	107.8	3.6%	12.04 knots	102.6	0.283
New York to Boston..................	312	118.7	2.1%	13.26 "	103.6	0.283
Boston to New York..................	312	118.9	2.2%	14.07 "	117.8	0.331
New York to Philadelphia............	240	107.0	3.7%	11.92 "	91.7	0.289
Philadelphia to Cristobal............	1,948	112.6	7.5%	12.04 "	99.9	0.302
	Passing thro' Canal					
Balboa to San Pedro.................	2,918	113.0	5.2%	12.40 knots	100.8	0.303
San Pedro to San Francisco...........	360	115.5	8.0%	12.30 "	102.0	.....
San Francisco to Seattle..............	803	111.4	14.0%	11.09 "	99.8	0.319
Seattle to Tacoma...................	24	110.0	0%	12.70 "	89.0	.....
Tacoma to Portland..................	384	113.4	12.25%	11.36 "	87.8	0.284
	Propeller bent on submerged log					
Portland to Balboa..................	3,801	107.4	14.4%	10.64 knots	92.4	0.306
	Passing thro' Canal					
Cristobal to Hamburg................	4,996	106.9	16.7%	10.30 knots	93.3	0.315
	Ship dry-docked and propeller fixed					
Hamburg to Glasgow.................	866	113.9	11.0%	11.87 knots	96.0	0.306
Glasgow to Liverpool.................	118	115.5	5.2%	12.60 "	99.8	....
Liverpool to Boston..................	2,840	113.9	9.8%	11.91 "	96.2	0.306
Boston to New York..................	312		*Data not available*			

Total...................... 20,232 nautical miles by observation.
Total Distance by Engines = 23,775 nautical miles
Total Fuel used at Sea........................... 7,151 barrels
Total Fuel used in Port........................... 340 "

Grand Total = ... 7,490 barrels, or 1,070 tons
Total Lubricating Oil used = about 2,000 Gallons



Plans of the motorship "Californian"

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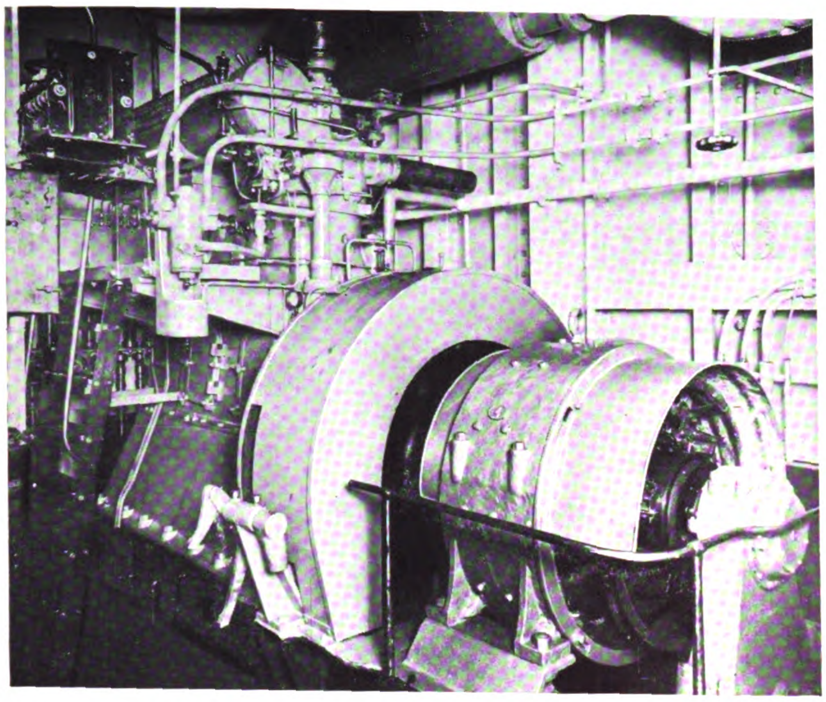
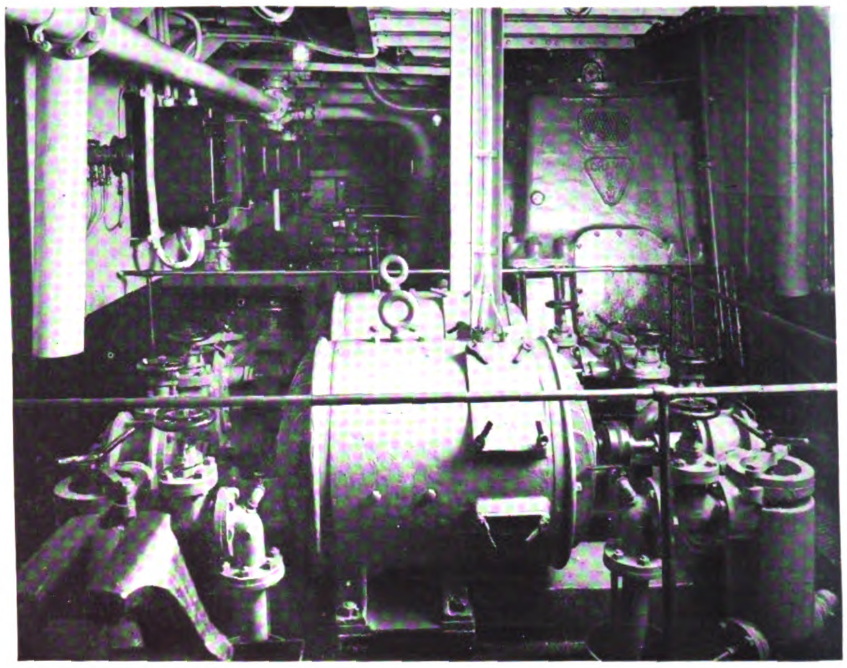


One of the Cramp-Diehl electric generating sets in the engine-room



Diehl electric-driven pumps in the engine room of the "Californian"

near future when our designers and builders become even more experienced. But to-day her owners can feel proud of their fine ship and her performance.

If the Shipping Board or any domestic company owns or operates a modern steamer of similar cubic capacity and average loaded-speed (650,379 cubic-feet and 12 knots), we will appreciate their courtesy if they will furnish us with similar data over a long voyage. Such will enable comparisons of incalculable value to be made and published for the benefit of American shipping in general.

Unfortunately the United American Lines have no steamships of similar size, the nearest being the old DAKOTAN class of reciprocating oil-burning vessels. These ships have a loaded displacement of 14,495 tons and a cubic-capacity of 453,700 feet, but as they only carry light bulky cargoes their performances are better than they otherwise would be because when loaded with such cargoes they only displace an average of 10,000 tons, weighing light 4,280 tons or only a 1,000 tons less than the much bigger and speedier CALIFORNIAN. So with the motorship far more cargo per ton of steel in the hull can be carried.

Their speed at this displacement is 11.5 knots, with the steam-engines indicating 3,200 horsepower instead of 4,000 i.h.p. as designed. But ten years from now the CALIFORNIAN'S Diesel will still be indicating 4,500 horsepower and her fuel-consumption will be just as good or even lower. Yet the steamer's daily consumption of fuel (*costing to-day about twenty cents less per barrel than the fuel-oil burned by the motorship*) is 34⅓ tons at sea and 6⅓ tons in port as against 14¼ tons at sea and ¾ tons in port for the CALIFORNIAN which has 196,679 cubic-feet additional cargo-capacity and ¾ knot greater speed. Hence the m.s. CALIFORNIAN'S fuel-bill at sea is about $157.00 per day, compared with the smaller and slower s.s. DAKOTAN'S fuel bill of about $329.00 per day with bunker-oil at $1.37 per barrel and the fuel actually used by the motorship at $1.57 per barrel. Any ship operator who cannot fail to see clearly the almost unbelievable advantages of Diesel power as hereby outlined and which has "got steam coming and going" had best take-up knitting for a living, because with the strong competition from other American firm's motorships as well as foreign motorship competition that he will have to face in a very few years, he will be forced-out of the shipping industry thro his fleet being idle and laid-up unable to operate at current rates.

COMMITTEE FOR MARINE OIL-ENGINE TRIALS

A joint committee has been formed in Great Britain for the purpose of carrying out a series of extended trials on a motor-vessel with a view to arriving at some reliable results useful to the naval-architect, and to the marine oil-engine builder. The committee is under the chairmanship of Eng. Vice-Admiral Sir George G. Goodwin, K.C.B., R.N., (ret.), with Mr. William H. Patchell as deputy chairman.

Members appointed by the Institution of Mechanical Engineers are: Sir Dugald Clerk, K.C.B., D.Sc., F.R.S., Dr. C. H. Lander, L. A. Legros, O.B.E., Prof. A. L. Mellanby, D.Sc., William H. Patchell, Capt. H. Riall Sankey, C.B., C.B.E., R.E. (ret.), and A. E. Seaton.

Members appointed by the Institute of Naval Architects are: George Anderson, G. S. Baker, O.B.E., Eng. Vice-Admiral Sir George G. Goodwin, K.C.B., R.N. (ret.), Eng. Com. C. J. Hawkes, R.N. (ret.), H. Ruck-Keene. James Barr, and T. Carlton, O.B.E.

Admirality Representative: Eng. Vice-Admiral R. B. Dixon, C.B., R.N.

Mr. Morrison of Messrs. Richardson, Westgarth & Co., of West Hartlepool and Middlesbrough some little time back offered one of the two vessels building for, at any rate some of, the trials proposed by the committee, and as the chairman of this new committee has recently been appointed a director of this shipbuillding firm, one may assume that this offer will be considered very carefully, when the time comes for these trials to be carried out.

The "All-American" motorship "Missourian," sister vessel to the "Californian," also operated by the United American Lines

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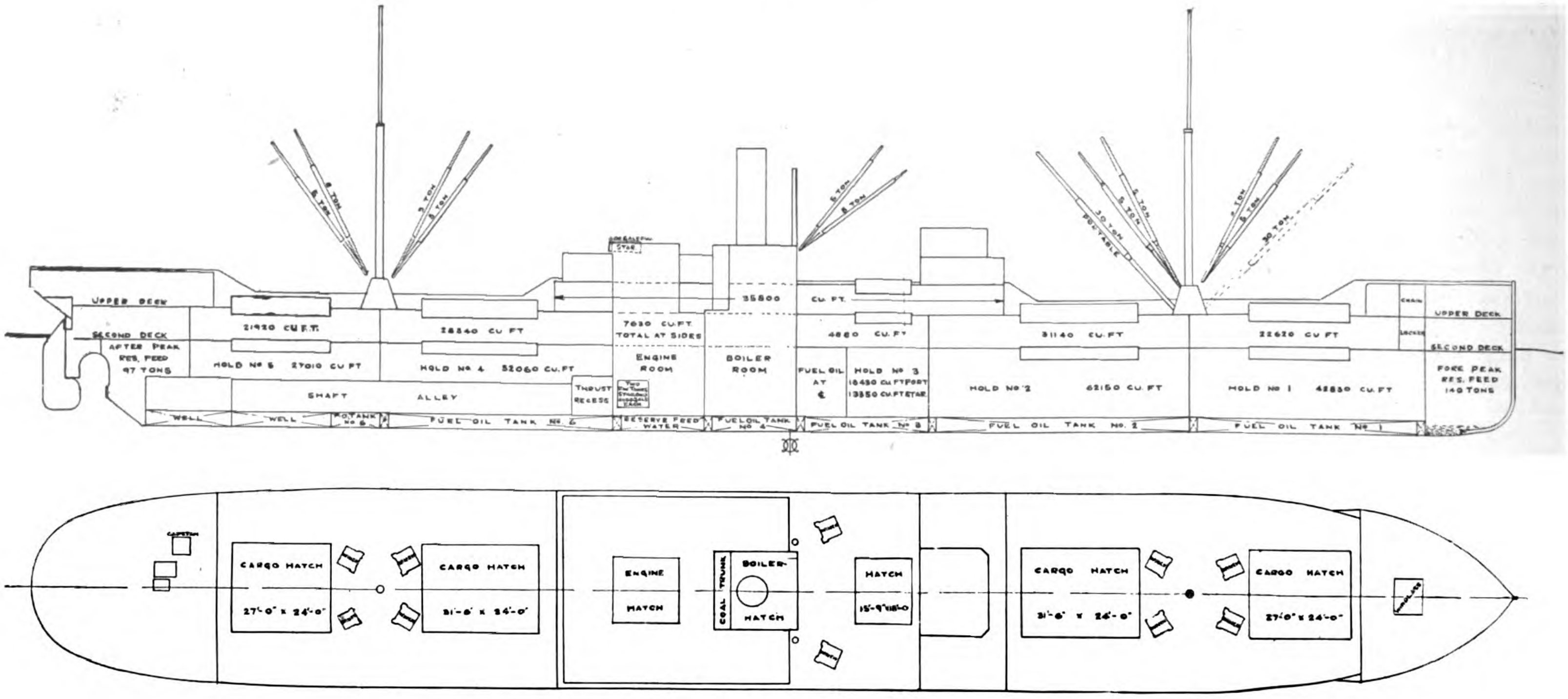


The steamship "Seekonk" prior to her conversion to Diesel power

Conversion of the "Seekonk"

The Interesting Diesel-Propulsion Job Now Under Way at the Cramp Shipyard

WHEN the work of conversion is completed, the vessel SEEKONK will be one of the most interesting motorships yet completed in this country. She will prove to the satisfaction of shipowners as to whether it is economical and efficient to buy steamship hulls from the Board, tear out the uneconomical steam-machinery and go to the expense of making certain hull constructional changes, and installing economical Diesel-engine power. She will be a complete conversion job as the steam deck-machinery will be scrapped and replaced by electrical equipment with the exception of the windlass and capstan which will easily be changed to motor drive.

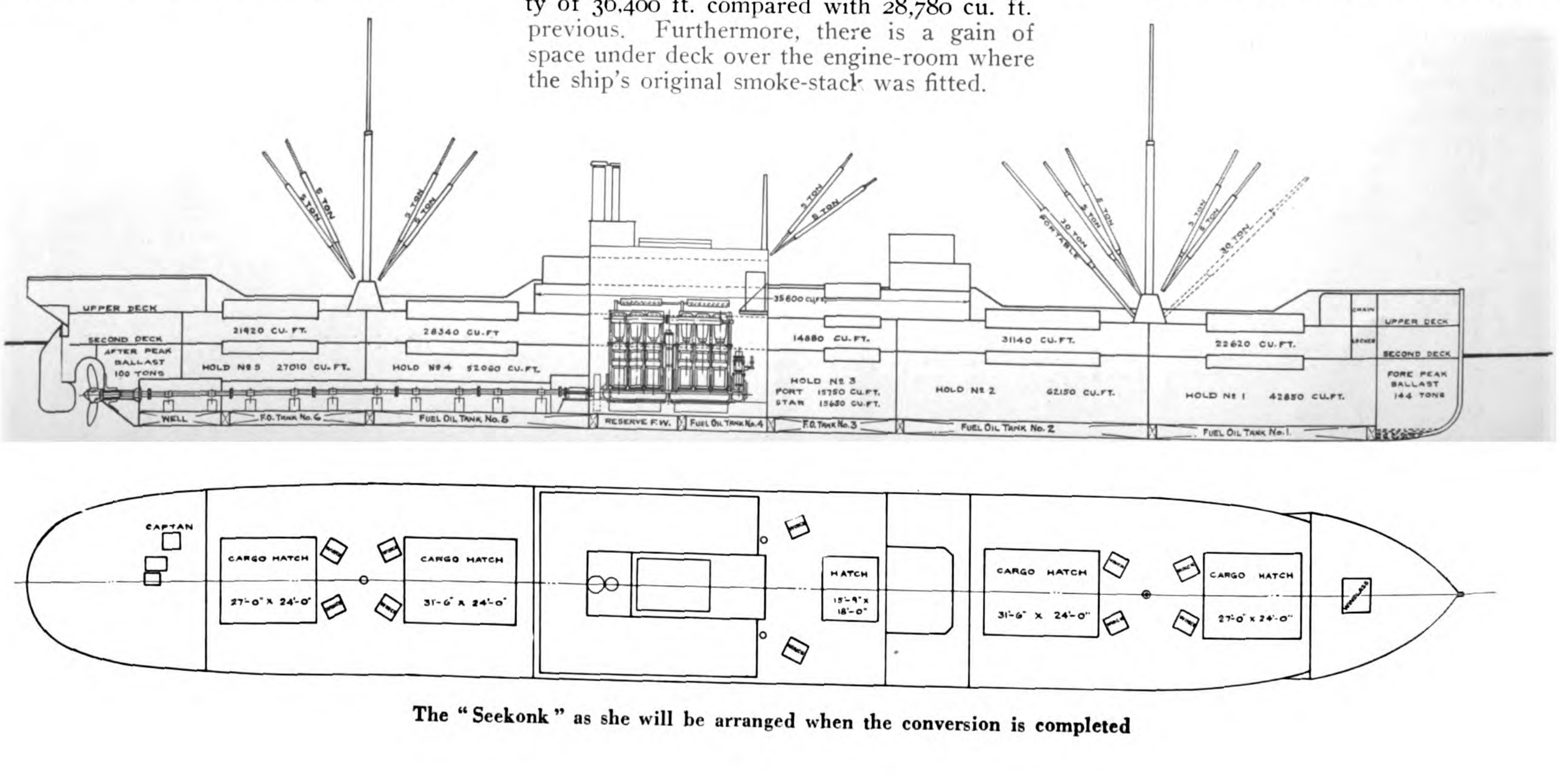
As previously reported in this magazine the SEEKONK was recently purchased by the Wm. Cramp & Sons Ship & Engine Company of Philadelphia, Pa. from the United States Shipping Board. At their own expense they are converting the vessel and at the present time are constructing her propelling and auxiliary Diesel-engines. She is of 7,775 tons d.w.c. and while the space and weight of the machinery will be practically the same as the original steam machinery, she will have the same average speed and will have a cruising radius four times as great as well as an additional freight-capacity of 1,000 tons of weight-cargo. What is unusual, she will have the same propeller speed as the steamer. In addition there will be a saving of eight men in the engine-room, and a reduction from her original consumption of 27 tons per day of fuel-oil at sea to 6½ to 7 tons, also a reduction in the port consumption to ½ ton from 5 tons. Consequently if the ship spends 182 days at sea and 183 days in port every year, there will be an annual saving of 3,382 tons (141,044 barrels) of oil annually.

Reference to the drawings will show the reason why the additional cargo-capacity is gained by the installation of Diesel power. This is practically due to the deep-tank being dispensed with and the entire space turned into hold No. 3, giving the same a cubic-capacity of 36,400 ft. compared with 28,780 cu. ft. previous. Furthermore, there is a gain of space under deck over the engine-room where the ship's original smoke-stack was fitted.

As a steamer her cruising radius was 10,000 nautical-miles, but will be 40,000 miles. Originally she had geared-turbine propelling installation designed to develop 2,500 shaft h.p. at 3,200 r.p.m. with the propeller running at 90 r.p.m. She was a single-screw Hog Island vessel of the following original dimensions:

Deadweight capacity (designed)	7,825 tons
Gross	5,784 tons
Length	390'
Breadth (moulded)	54'
Depth (moulded)	32'
Total cubic-capacity (bale)	373,220 cu. ft.
Total cubic-capacity (grain)	400,201 cu. ft.
Fuel-oil capacity	1220 tons
Designed fuel-consumption	31½ tons per day
Designed speed	11½ knots

The SEEKONK was built in 1919 and steam was generated by three Babcock-Wilcox water-tube boilers. Her new propelling machinery will be the American-built Burmeister & Wain type slow-speed, long-stroke, four-cycle Diesel engine now under construction at the Cramp Shipyard. Its six cylinders will be each 29⅛" bore by 59" stroke, and together will have an output of 2,300 i.h.p. at 85 to 90



The "Seekonk" as she will be arranged when the conversion is completed

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r.p.m. which will be sufficient to give a loaded-speed of 10½ knots.

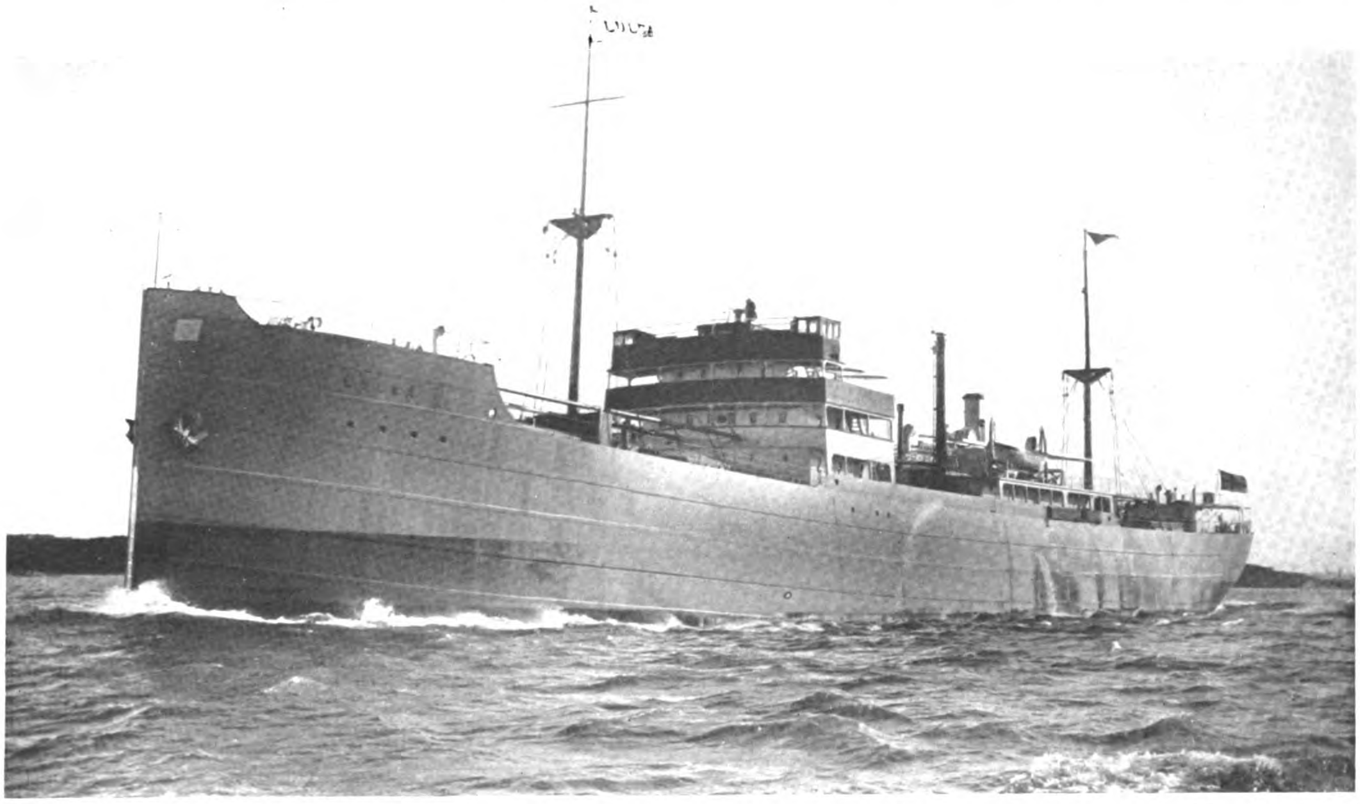
It has been necessary to install a new line-shaft and a new thrust-bearing, but the old tail shaft is being retained. As before stated all the steam deck-machinery is being removed, and the new equipment will consist of ten A. E. G. electric winches and a hydro-electric steering gear. Power for this and other equipment will be furnished by three Cramp-B. & W Diesel-electric generators of 100 b.h.p. and 67 K.W. These auxiliary Diesel engines will be of the new type specially developed by Burmeister & Wain for ship's generator drive. She is equipped with Diehl motors.

We have referred to the reduction in the engine-room crew. This is arranged as follows:

	Steam	*Diesel*
Chief Engineer	1	1
1st. Asst. Engineer	1	1
2nd. Asst. Engineer	1	1
3rd. Asst. Engineer	1	1
Electrician	0	1
Oilers	3	3
Water Tenders	3	0
Firemen	6	0
	16	8

While there will be two men on watch while at sea one man only will attend to the main engine, the other man operating all the auxiliary machinery.

Let us therefore total the features that will be gained by the conversion:—A saving of about $150,000 per year in fuel; the earning value of 1,000 tons additional cargo; saving in wages and food of eight men and large quantity of fresh water for boilers is dispensed with. These factors should be worth at least $250,000 annually in aggregate. That is why Cramps are converting the vessel.



Grangesberg-Oxelofund's ore-carrying motorship "Lulea," built and Diesel-engined by the Götaverken, which recently ran successful trials. The sister motorship "Luossa" has just been launched. Both vessels have Burmeister & Wain Diesel-engines installed

AMONG THE MOTOR WORK-BOATS

Ferrier & Lucas have ordered a 20-24 h.p. Kahlenberg engine to be installed in a tow-boat at Vancouver, B. C.

Guy E. Craig, manager of the Seattle office of Fairbanks-Morse & Co., has just visited the company's factories in the middle west.

Johnson Brothers of Port Angeles, Wash., recently installed a 200 h.p. Fairbanks-Morse oil-engine in a tow boat. This oil engine replaces a distillate-engine.

The mail-boat CARMEN owned by William Neil of Ketchikan, Alaska, has been equipped with a 60 h.p. Fairbanks-Morse oil engine at the Estep plant in Seattle.

David W. Dickie of San Francisco, has designed two tug-boats for the California and Oregon Lumber Co. They will be used on San Francisco bay and will cost $30,000 each.

Dr. McMillan recently returned to Boston, Mass., from a scientific expedition to the North in his schooner BOWDOIN, which is equipped with a 45 h.p. Fairbanks-Morse oil-engine.

Trial trips of the new Bolinder-equipped fishing-schooner LARK took place on October 8th at Gloucester, Mass. A run was made to the Fish Pier at Boston.

The coal strike, which resulted in severe coal shortage along the New York State Barge Canal, prevented regular operation of steam-tugs on those waters. The advantages of oil-fuel, however, have been forcibly demonstrated by the Transmarine Line's Nelseco-Diesel-engined tugs, which have never been held up for lack of fuel or other cause.

WORK BOAT ACTIVITY IN FLORIDA

It is gratifying to note that several oil-engined craft are being built in the South. From Florida alone come reports of considerable activity.

Smith & Bowen of Jacksonville, engaged in the freight business between that city and West Palm Beach are installing a 60 h.p. Fairbanks-Morse surface-ignition oil-engine in their boat ECHO in place of a gasoline-engine. This change was due to the reliable and economical service given by a 45 h.p. engine of this same make which was installed about eighteen months ago in their freighter FIDES.

Another freight-boat operated out of Jacksonville on the Daytona run by the Jacksonville-Daytona Boat Line has been equipped with a 45 h.p. Fairbanks-Morse oil-engine and put in service. This boat, the DAYTONA, makes the third freighter operated by this company, all being equipped with the same make of engine. The other boats, the INDIAN and the OSCEOLA were put in operation two and three years ago respectively.

The Halifax River Boat Line of Daytona is having a new freighter built for the Jacksonville-Daytona trip which will be equipped with a 45 h.p. Fairbanks-Morse oil engine.

Two tug-boats for service in Jacksonville harbor are under construction, both to be propelled by 60 h.p. Fairbanks-Morse engines. The FLORIDA will be owned by W. T. Coppedge and the KATY S. by Capt. A. G. Spaulding, both of whom are thoroughly "sold" on oil-engine power.

SHAFT HORSEPOWER FUEL-CONSUMPTIONS OF DIESEL ENGINES

Ship.	*Kind of oil.*	*Specific gravity.*	*Temperature of oil. in °C.*	*Consumption per B.H.P.-hour. in lb.*	*Date.*
Kedoe	Borneo	0.905	37.5	0.376	13/3/22
"	Rotterdam	0.858	35.5	0.366	4/3/22
"	"	0.86	31	0 368	20/12/21
"	"	0.865	24	0.367	9/12/21
Leise Mærsk	Brunsbuttel	0.912	15	0.357	12/11/21
"	"	0.888	15	0.357	29/9/21
"	"	0.888	15	0.357	21/9/21
Malaya (24 hours)	Borneo	0.905	36	0.362	22/12/21
" "	"	0.905	37	0.360	10/12/21
" "	"	0.916	32	0.370	12/9/211
Afrika "	Tarakan	0.941	27	0.365	12/11/2
" "	"	0.93	37	0.368	19/11/20

Recently we had to criticise the claims made by several well-known American consulting-engineers that Diesel motorships had consumptions (for all purposes) of about 6/10 of a pound per shaft horse-power. The above performances of four Burmeister & Wain motorships support our remarks.

RADIO SETS FOR TUGS

Tow-boat owners are indicating their progressiveness by not only adopting the Diesel and the surface-ignition oil-engine for their new installations, but they are also equipping their tugs with radio sets. With this equipment it is possible to notify them of towing jobs without their having to come into port and go out again, often over the same route and the cost of the wireless equipment is saved many times over in the increased business and fuel-saving effected.

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Vickers' Merchant-Ship Oil Engine

Most Recent Design of this Well-known British Airless-Injection Diesel Motor

FOR years Vickers oil-engines were constructed in strict secrecy, because until the end of the war all Diesel motors built by this great British firm were for naval craft. In this connection it is interesting to recall that the first descriptive article on the building and design of Vickers engine was published in the Special European Development Number of this magazine in 1919 following an Editorial visit to their plant at Barrow-in-Furness. Up to that time all that was known about the Vickers system of airless-injection of fuel, or solid-injection as it was termed, was such as could be secured from patent specifications.

But Vickers have built many high-powered units, not only for submarines and monitors, but also for merchant ships, and such vessels have made splendid records in service. The first big Vickers tanker was the MARINULA which had cruiser type engines installed; she was followed by the NARRAGANSETT and five sister ships, the latest of which is the SCOTTISH MUSICIAN. But after the NARRAGANSETT had been placed in service, some modifications were made to the design of the engine based on the experiences with her twin motors. It is the very latest Vickers design that forms the subject of this article. However, it must not be inferred that the NARRAGANSETT has been other than reliable in operation, because up to the middle of this year she had covered 104,800 nautical miles at an average speed of 10.12 knots on a consumption of 9¾ tons of fuel per day. She is of 10,050 tons deadweight.

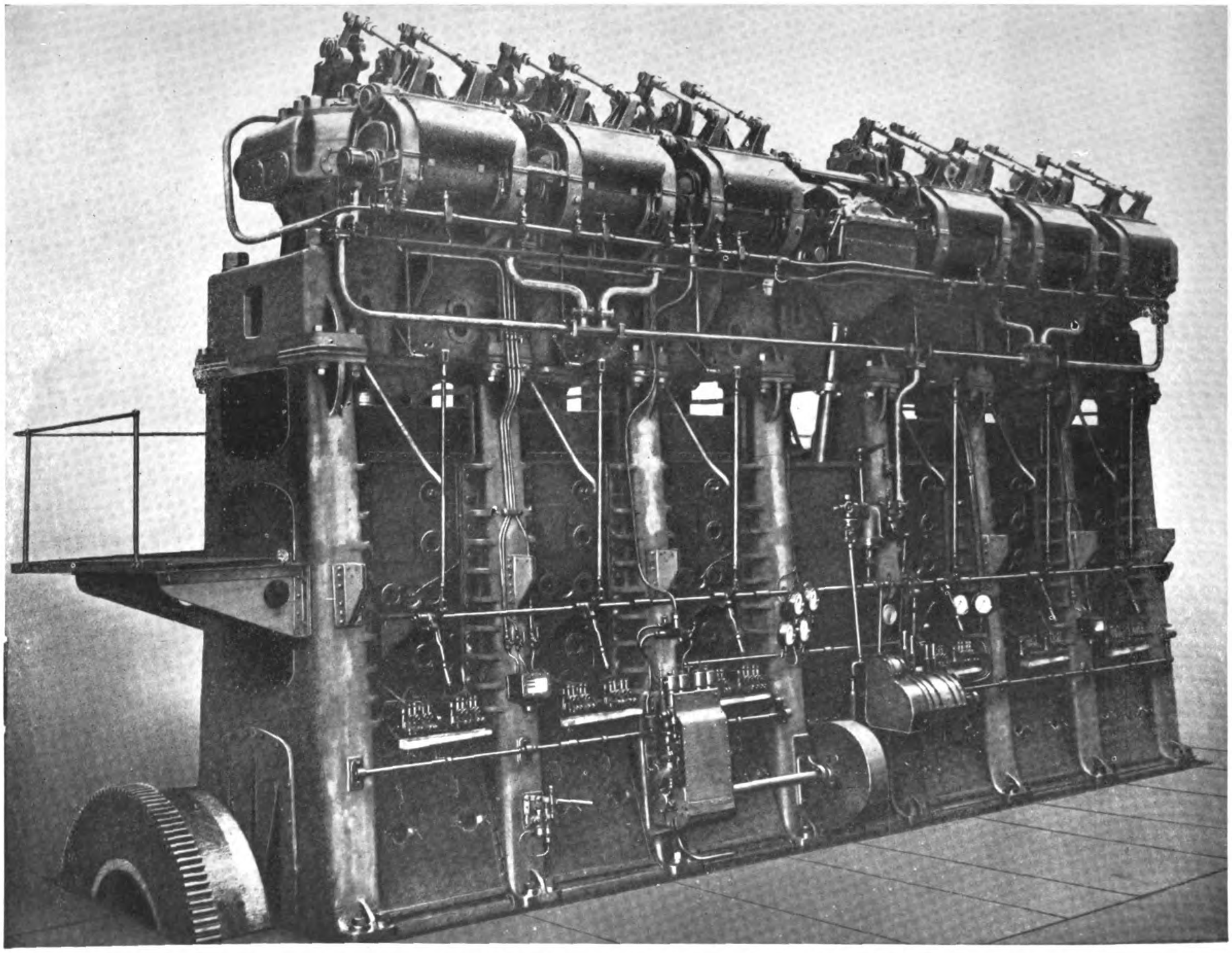
We reproduce photographs of one of the two six-cylinder Vickers heavy-oil engines as fitted in the twin-screw, 10,000 deadweight, 10½ knot motor tanker SEMINOLE, of the Anglo-American Oil Company's fleet, and in the motor tankers SCOTTISH STANDARD, SCOTTISH MAIDEN, SCOTTISH MINSTREL, and SCOTTISH MUSICIAN, vessels of practically similar build supplied by Vickers to Tankers Limited. It will be realized that in the illustrations the gratings have been removed to enable the machinery to be seen clearly.

Considerable interest has been raised both in this country and in England by these vessels, because of their engines being of the airless injection type, the blast compressor and gear being entirely omitted. In these circumstances, though the general features of the Vickers commercial marine-engine have been described in former issues as referred to, our readers will doubtless be interested by a description of the latest type as now illustrated.

First as regards the main particulars. Each of the six cylinders has a diameter of 24½ inches with a stroke of 39 inches, and works on the four-stroke cycle. The rating for continuous running is 1,250 shaft horse-power at 118 r.p.m. This power entails an indicated mean pressure of about 95 lb. per square-inch which the makers regard as a conservative rating for this particular design and leaves a considerable overload for contingencies.

Each cylinder barrel is "splayed-out" at the bottom into a square base which is bolted to its neighbor, thus forming a stiff entablature resting upon the columns. The liner fits into a recess in the top of the cylinder and passes through a gland at the lower end, the construction being normal except for special cooling arrangements at the top. Each column is a hollow trestle straddling the solid-forged crankshaft and resting upon a cast bedplate, made in two sections and forming an oiltight bottom to the engine. Rolled tie-rods pass through the columns and connect the entablature to the bedplate, the bottom nuts being housed in cored cavities in the base while the upper nuts, as can plainly be seen, bear on the upper side of the entablature. The columns themselves, though bolted top and bottom, do not take the main forces due to compresion and firing, but are simply concerned with giving rigidity to the engine and taking the forces on the guides. The single guides extend from column to column on the inboard side and are of the slipper type, water cooled on the ahead side.

This leaves the back of the engine clear, and by removal of light casings the whole of the working parts are laid bare for refit when necessary. Extreme accessibility is thereby obtained. Above the grating in one of the illustrations can be seen the diaphragm plate closing the top of the crank-chamber. The piston-rod passes through a shallow gland in this



The latest design of Vickers airless-injection marine oil-engine of 1,250 b.h.p.

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plate so that any burned lubricating-oil from the pistons is prevented from falling in the crankcase. This illustration also shows the piston-cooling pipes with visible discharges outside the crankcase. No working joint in this water service is inside the crankcase and any leakage of water at the glands takes place on the upper side of the diaphragm plate and is drained to the bilge.

The connecting-rod is of marine type with cast steel ends lined with white metal. The top ends are of exceptionally large size and this, combined with a very complete system of forced lubrication, has been found to result in the wear being negligible. The main bearing-shells are circular externally so as to render inspection easy, and are also lined with anti-friction metal. Camshaft drive is by spurs and bevel wheels, the makers regarding these as more durable than spiral wheels. The vertical shaft for this mechanism can be seen in the middle of the engine, passing between the crankcase and the camshaft casing.

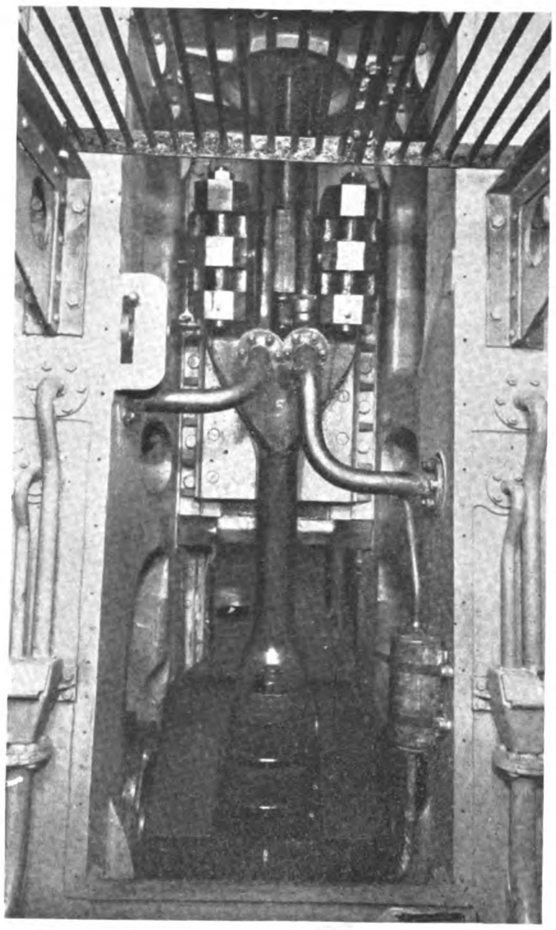
Separate cylinder heads are fitted, secured by eight studs and making a spigotted joint with the liner. They have ample cleaning doors, while in each head are mounted an inlet and an exhaust valve, a fuel-injection valve, an air-starting valve and a cylinder safety-valve. Operating gear for the running valves is concentrated at the upper platform and is plainly shown, but in the illustration the light casing over the cams has been removed. It indicates the large, wide rollers and the substantial pins upon which they are mounted. The cam rollers being of special chilled cast-iron and running in oil are found to be practically immune from wear, and it certainly seems that in these details the Vickers engines are particularly robust. The vertical injection-valve box is in the centre of the head and the valve is worked by a ball-crank from the horizontal push-rod to which the upper arm of the fuel-cam lever is attached.

Great attention has been paid to the detail of the injection-valve, which is separate from its spindle and is kept on its seat by a spring bearing directly upon it. The spindle is thus in tension only, and to regrind the injection-valve it is necessary only to remove the nozzle end after which the valve can be taken out and ground into the nozzle, leaving the spindle and spring in position. A strainer with holes smaller than those in the nozzle is fitted close to the sprayer and so prevents choking of the nozzle. The nozzle is made of special steel, and is readily replaceable at a cost of a few dollars, yet in the NARRAGANSETT these nozzles when examined after running 105,000 miles were still without measurable wear.

It will be observed that the inlet and exhaust cam levers are mounted on eccentrics on the fulcrum shaft. By partially rotating this shaft during reversing, which is described below, the rollers are lifted clear of the camshaft which may then be slid longitudinally, after which the fulcrum shaft is turned back to the operative position.

The inlet-valves are of nickel steel and solid; but the exhaust-valves are hollow and are water-cooled, the water passing by means of an internal pipe to the bottom of the valve and returning up the stem. The water supply to the valve and the discharge from it are through flexible pipes. This system is different from that of most makers, but the extra expense seems to give good results, judging from the veteran naval tanker TREFOIL, in which for 18 months no exhaust-valve was even examined, and from the NARRAGANSETT where the valves, on being opened out for the first time during the examination at the end of her twelve months' guarantee, were found to require only a light grinding in.

The air-starting valve in the cover is really a simple non-return valve, the main cam-actuated valve being mounted under the cam shaft. The air cams can be seen under the couplings of the fulcrum shaft. As is well known, rusting is accelerated in compressed-air, and as some stiffness might be expected with ordinary valves after a three weeks Atlantic crossing to the Gulf, special attention both to design and material has been paid. The cylinder valve can be worked up-and-down by hand when the engine is running, and also turned on its seat, while the cam-operated valve, though it falls from the cam when starting-air is shut off, yet is not quite clear of it, and is therefore kept gently moving as long as the engine is running. If necessary this valve can be removed while the engine is running, so that nothing has been left to chance in arranging for sure and certain maneuvering at any time. Such details show the extent to which the builders have used their lengthy sea experience with warship oil-engines to prevent the little hitches that occasionally might give serious trouble.



Looking into connecting-rod chamber of Vickers engine. Note piping for piston cooling

Absence of the injection-air compressor and its accessories is one of the first points that strikes one when examining the engine. Its place is taken by what for all practical purposes may be regarded as an ordinary high-pressure fuel-pump, to be seen on the third column from aft. The discharge from this pump can be traced to the fuel main or rail under the camshaft brackets in the illustration of the engine. From the rail a lead is taken to each injection-valve, so that the system is very elementary in principle. In twin-screw ships there is a cross connection between the fuel mains of the two engines so that should, by any extreme chance, one pump be out of action in all four plungers, the two engines could be run from the one pump.

On the right of the operator are two pressure gauges. One is for the compressed air starting bottles, the other shows the fuel pressure. The maximum air-pressure is 600 lb., but 180 lb. is sufficient for maneuvering. Full-power fuel pressure is just under 4,000 lb., the pressure being reduced to about 2,000 lb. at low engine speeds. The speed control is effected by a lever connected to a shaft running along the front of the engine and seen just above the gauges. This shaft is connected to a vertical rod at each cylinder and so controls the opening of all injection valves simultaneously, at the same time adjusting the fuel-pump output to suit. Any one spray-valve can, in case of necessity, be cutout of action by a lever just over each piston lubricating-pump.

To reverse the engine the speed lever, the second from the left, is brought forward, thus putting all the fuel-valves out of action and the engine stops. The reversing lever, the end one on the right, is freed by the control being at "stop" and on being brought forward it admits air to the reversing servo-motor cylinder. This is on the top platform at the back of the engines in the center. This oscillates the fulcrum shaft, and when the valve-lever rollers are clear, the camshaft is moved longitudinally by the same mechanism, thus bringing the astern cams under the rollers. The fulcrum shaft now turns back and drops the valve levers on the cams.

At this stage, which is indicated by a pointer at the starting station, the air lever, the long one on the left is automatically unlocked and being pulled forward admits air to the starting main shown just above the column tops. Air is now right up to the cam-operated valves which are forced up into their closed position except where a starting cam prevents this. In this case air passes to the cylinder in question through the non-return valve on the cover and the engine begins to turn on air, other starting valves being operated in sequence as the camshaft rotates. As soon as the engine is freely turning, which is shown by a rotating pointer facing the engineer, the speed lever is pushed forward and the fuel-valves come into play. The engine immediately fires, after which the air lever is pushed in, and the engine is running on fuel alone. It will be noticed that there is no question of cutting air off some cylinders first, or of admitting fuel to them before others, so that the control gear is very simple indeed.

Reversals from full-speed can be carried out in under 8 seconds, most of this time being taken in travel of the servo-motor which is purposely slowed down by means of a dash-pot cylinder. This latter cylinder is used as a power cylinder when carrying out emergency reversing by the stand-by hand oil pump. The reversing and starting gear has been thoroughly tested judging from the ship engineer's report of 757 engine orders during a trip of 36 miles on the Manchester Ship Canal.

We have gone at some length into the description of this starting gear in view of the attention that the airless injection type of engine has been receiving from American vessel owners. As we have indicated, Vickers were the first to make a practical success of this system for high-compression engines, and it was from their works that the term "solid injection" came, which MOTORSHIP changed to airless injection as better indicating the system of injecting the fuel. As they are responsible for some half-a-million brake horse-power in high-powered propelling sets, any departure by them may be regarded as based upon the results of blue-water experience and worthy of careful scrutiny. This form of injection undoubtedly was regarded as a dream by many before it became known that all of the British submarines and some of the Admiralty tankers and monitors were fitted with it. The performance of the NARRAGANSETT whose record has from the beginning been published and latterly that of her sister ships,

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bring out further facts. This and the extent to which other makers are now taking up this system or experimenting with apparatus similarly designed to render the blast compressor unnecessary, show that the airless-injection system is one that has at last forced general recognition for itself. When put forward by an experienced firm, it must be admitted as a worthy alternative to the air-injection type.

In using sea water for cooling purposes throughout, Vickers are maintaining a practice not universally followed. Salt-water cooling, for pistons in particular, entails special consideration of design and in muddy waters trouble has been experienced before now, but the extra complication and weight of the fresh-water scheme is a point not to be overlooked. Vickers gained valuable experience with one of their Admiralty tankers which, during the War, had to ply in Eastern waters without a high suction, and have come to the conclusion that salt-water circulation can be made quite satisfactory. They take great trouble to prevent formation of deposits and as they have certainly had no trouble with mud in their commercial engines, though these have been running up the Mississippi and in the Persian Gulf, it may be taken that they have been repaid in results for this attention.

It is of interest to note that it is even possible by means of a switch-cock to wash the covers and cylinders through by a reverse flow of water without stopping the engines.

The arrangement of the auxiliaries is often largely a matter of judgment according to the circumstances of the case. In the NARRAGANSETT all auxiliaries were driven from the engine, but in the Scottish vessels the circulators and lubricating pumps are independently driven by electric motors, the main engines being clear of pumps. There is a good deal to be said for either system, but the wear and tear of the electric pumps will doubtless be less and the comfort of the engineers increased by their use.

The six vessels have made voyages with the exception of the SCOTTISH MUSICIAN which recently ran trials, her delivery having been delayed by labor disputes in England. After her trials she proceeded to Texas, loaded and left Port Arthur for England on Sept. 12th. By the time this appears in print she will have arrived, unloaded and sailed again.

Eight Years Service of a Converted Steamer

Successful Operation of the Single-Screw Motorship "Songdal" — Forty-six Per Cent. of the Total Fuel Has Been Consumed by the Donkey-Boiler

By ALBERT ELISHAK
Third Engineer of the "Songdal"

(Part II)

(*Continued from page 775, October issue*)

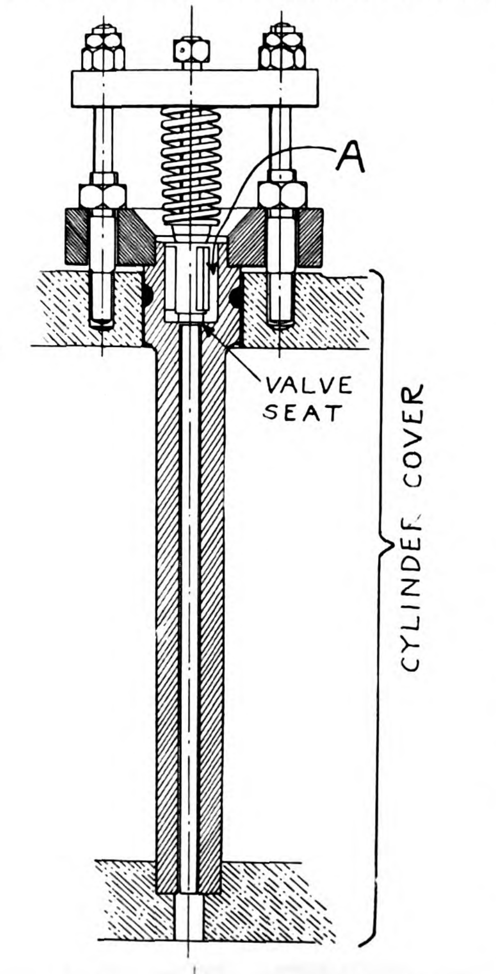
AFTER two or three weeks running we automatically replaced the valves with a view to maintaining the uncooled valve seats as far as possible from corrosion due to the poor quality of fuel. Even then it was occasionally necessary to re-seat the valve seats before grinding. One by one all six starting-valves were overhauled during the past twelve months. Removal of the valve-box is so infrequent that it requires considerable labor and time whenever it has to be done because of corrosion in the long intervals between removals.

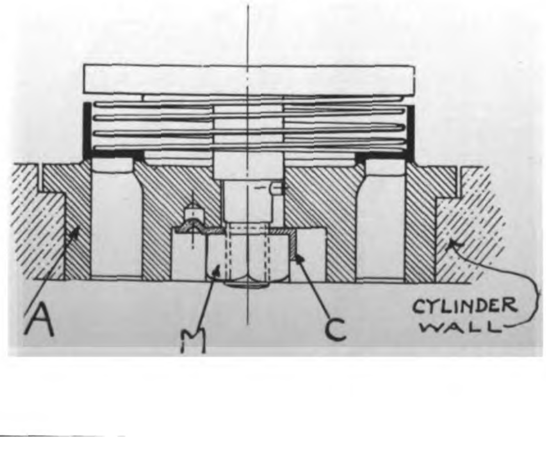
The seating of the relief-valves is nearly always tight, being carefully bored and ground frequently. The attached illustration shows this arrangement. The upper part of these vertically mounted valves have a cone form which tends to gather splashing lubricating-oil, water and dirt. Consequently, soon after the cleaning space 'A' becomes full-up and small particles of dirt work their way below the valve through corrosions in the valve-seat with the result that the products of combustion are influential in forming a hard and enclosing layer of several millimeters in thickness. In such a condition the relief valves cannot operate properly, so we attend to them whenever necessary.

Sometimes one of the channels of the indicator-valves becomes blocked by uncompletely burned particles and have to be cleaned. Packing of the main plungers of the fuel-pumps is made of leather which is replaced once in ten months. The small amount of fuel that leaks is gathered and after straining is pumped up to the daily fuel service-tanks. Generally speaking, the fuel-pumps work very satisfactorily.

In addition to the reference already made to the air-compressor I will mention that compression is effected in three stages, the compressor being of the four-cylinder type, each pair working in tandem and are at an angle of 30 degrees symmetrically to the center line. But this design of compresser has been abandoned by Burmeister and Wain. The two connecting-rods are arranged side-by-side on the same crank, which is an extension of the forward end of the main engine crank-shaft and has no outer bearings. On the port side is the low pressure cylinder No. 1 and the high pressure cylinder; while on the starboard side is the low pressure cylinder No. 2 and the intermediate cylinder. There is no regulation on the quantity of air drawn in on the suction stroke, but the dimensions are such that when the engine is continually running both at normal and slow speed, not only the full amount of injection-air is delivered, but there is a sufficient surplus to maintain constant pressure in the maneuvring air-tanks.

During the maneuvring period some injection-air is generally lost every time the engine is started so the overflow to the starting-air tanks is cut off in order to maintain the necessary compression and injection air. Incidentally it may be stated that the lowest speed the engine has yet run at was 68 r.p.m. for a period of 10 minutes. Even then the fuel control levers were not drawn back to the fullest extent and the quantity of fuel could still be diminished and the engine run at lower speed.





A detail of construction which should not be overlooked, is that of the air-valves for the low and medium pressure cylinders. The suction and discharge valves are interchangeable, and are fitted in the cylinders to open inward and outward respectively. The illustration Figure 2 is of the discharge valves which are so arranged as to leave the nut "M" on the inside of the cylinders. To my mind the fastening of this nut is not ideal. The copper plate "C" is on the one side pressed into a drill hole in the valve body "A" and on the other side is bent up against one or two of the flats of the hexagon-shape nuts.

It will be noted that the slacking of the nut comes into touch with the piston when at its highest position on the upward stroke. That the slacking can occur has already been proven in some other engines. In this particular engine we had an experience with a nut on the low-pressure cylinder, only the nut was of a very hard material and burst into a thousand pieces. So we were thankful that the compressor was not otherwise injured. But, of course, the interior of the cylinder had to be thoroughly cleaned-out and the engine stopped for this purpose. But, in the case of the motorships SONGYAR and PACIFIC the slacking of the nut caused a bursting of the cover on the medium pressure cylinder.

It has come to my knowledge that in the case of a new Swedish motorship with similar design but different build of engines, changes have been made in connection with the valves so as to eliminate the possibility of this danger. In fact we must remember that since the SONGDAL's engine was constructed much progress has been made.

Next we refer to the system of air-starting and reversing which is of the early type and has been changed with engines of more recent design. All six cylinders of the main engine are thrown on to fuel simultaneously, but there was no disadvantage resulting from this system, the engine always starting with every reliability. This applies to the reversing mechanism with the rotary motor on a vertical shaft. Once this engine refused to turn owing to the slides having become stuck by rust so the maneuvering was carried out by means of the handwheel. In two riveted cylindrical tanks, each having a capacity of 8 cu. meters starting-air is stored at 426 lbs. The simplicity of maintenance is one of the advantages of this arrangement, as compared with a battery of steel air-bottles. But there is difficulty in making

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the riveted tanks thoroughly tight. Consequently, when the tanks were charged with the highest pressure and all valves closed there was a drop in the pressure of about 2 atm. or 28.4 pounds per square inch in 24 hours when the engine was not in operation. As a matter of fact, during one of the most extended maneuvring periods on a voyage we used up the air until the pressure dropped down to 11 atm. without having started up the auxiliary compressor. Nevertheless, starting was completely reliable and probably would have continued to even lower pressures.

I previously referred to the auxiliary air-compressor and its duties. The two-cylinder Diesel engine driving this set is of the Burmeister & Wain stationary type with air and fuel starting for each individual cylinder through inter-connected hand levers. During one December when we were at Boston the temperature was very low and the engine was using a light fuel-oil of 0.865 specific gravity, we could not get the engines to fire without special preparations. First, we warmed up the suction-air by setting some kerosene soaked cotton-waste on fire beneath the air-suction strainers. However, we never had similar difficulty with the main Diesel engines, this only being with the auxiliary engine, which by the way, has its own lubrication circulating system for all the bearings. There is a small rotary pump mounted inside the crank-case and this enables the maximum amount of economy in lubricating oil consumption. Unfortunately, the exact figures are not available as the engine was not run for any lengthy period, the longest being two hours. During the total of ten months this auxiliary engine was not in use more than 22 hours altogether.

The reason for driving all the other auxiliaries by steam was the ship having originally been a steamer her first owners, the East Asiatic Company, desired to retain all the steam-driven deck machinery, consisting of ten winches and one anchor-windlass, steering-gear and steam piping. Whether the saving in first-cost against the conversion from steam to Diesel-electric driven auxiliaries is justified when taking into consideration the high fuel-consumption, I cannot say. This matter perhaps could be decided by calculating the expenses during the eight years since this particular vessel was converted. Personally, I have no doubt as to the result.

At this point I deal with the practical side of this problem and come to the matter previously mentioned; namely, the dependence of the main engine upon the donkey-boiler at sea. This matter should be dwelt on because of the increasing tendency to convert steamers into more economical Diesel motorships and probably is a strong temptation to retain as far as possible all deck machinery, piping, etc., which can only lead to similar arrangements to those we have on the SONGDAL.

But the entire separation of all the auxiliaries, including cooling-water and lubricating-oil pump, from the main engine as adopted by Burmeister & Wain should be arranged throughout. This not only insures a continued constant delivery of energy, but also enables immediate replacing by a spare in case of trouble. These conditions are fulfilled by Diesel-electric driven auxiliaries, the Diesel-engine delivering for long periods the constant speed required. In case of accident the spare set is ready for instantaneous starting.

Furthermore, the reliability of electric generators and the electric motors is far in advance of steam boilers. Not only does the quality and quantity of steam fluctuate, but such a plant is very dependent on the operation of the feed-pumps and fuel-oil pumps, as well as on the skill of firemen. Also, when there is any trouble with the boiler it is generally impossible to at once use the spare boiler, as it requires not less than eight hours to get up steam.

With such conditions it is of no use separating the cooling-water and lubricating-oil pumps from the main engine, and to place them on the same flat with all the pumps and auxiliary machinery for ships purpose. The cooling-water and lubricating-oil pumps are far more important than the general-service pumps, such as deck and ballast pumps, lighting-set, etc. In fact they are almost part of the main Diesel engines because the latter depends upon their steady operation in the same way as on the air-compressor.

Many times, especially during the night watches when the 15 h.p. lighting-set was in operation—a relatively heavy steam consumer—it was necessary to reduce the speed of the main engine for some time owing to the cooling-water and lubricating oil-pumps not having sufficient steam to deliver the required pressure. When it was found necessary to clean the boiler tubes or to tighten a leaking flange, even the main engine had to be stopped. A motorship which has to stop its main engine when there is no steam available is a misnomer.

It will be easily understood that the daily fuel-consumption would diminish considerably if the cooling water and lubricating-oil pumps were driven directly off the main engine. Both these pumps are the only auxiliaries which run all the time the ship is at sea. Consequently, they consume about 30 per cent of the total amount of steam. One of the lubricating-oil spare pumps was needed when the temperature of the cooling sea-water rose about 15 degrees centigrade. The re-cooled lubricating-oil otherwise would have become too hot to obtain the necessary oil pressure by means of one pump. All the other pumps run for short periods each day. But, as already inferred, all auxiliaries should be separate from the main engine and operated by Diesel-electric drive.

If asked to give a summary about the running conditions of the auxiliary machinery, probably I could say that it was sufficient to look occasionally over the main Diesel-engine during the watch, but the boiler and entire pump equipment demanded constant supervision.

Before closing I wish to express my thanks to Chief-Engr. Anders Liljefors of the motorship SONGDAL for placing at my disposal figures regarding the consumption, etc. Also I must express my appreciation of the courtesy of second officer Leif Svensen for his courtesy and kindness in assisting me to translate this article during our common free watches.

Steamer "Lake Sunapee" To Be Converted

A 825 Shaft H.P. Pacific Werkspoor Diesel Engine Will Be Installed

ONE of the 825 shaft h.p. Pacific-Werkspoor Diesel engines recently purchased from the U. S. Shipping Board by Frank Lynch, President cf the Benson Lumber Co. of San Diego, Calif., will be installed in the Board's freighter LAKE SUNAPEE which Mr. Lynch purchased some time ago. This vessel is a single-screw steel freighter of the following dimensions:

Deadweight capacity	2,922 tons
Cargo cubic-capacity (grain)	127,949 cu. ft.
Fuel-capacity (coal)	410 tons
Daily fuel-consumption	20 tons
Speed	10 knots
Length	251 ft.
Breadth (moulded)	43′ 6″
Depth (moulded)	21′
Loaded Draft	18′ 6½″
Steaming radius	4,920 nautical miles

She was built by the Toledo Shipbuilding Co. of Toledo, Ohio, in 1918, and at present is equipped with one triple-expansion engine of 1,250 i.h.p. and two Scotch boilers.

The LAKE SUNAPEE left New York at the end of September en route for San Francisco and upon her arrival it is intended to call bids from various Pacific Coast yards for the work of removing the steam machinery and installing Diesel power. When completed the ship will be used for hauling lumber on the Pacific Coast. Her new machinery should give her an increased speed and she should average about 10½ knots in service fully loaded. We estimate that additional cargo space will be gained by the fitting of Diesel machinery. While the figures on the existing machinery weights are not available we think that there will be considerable saving because the Diesel engine only weighs 110 tons without auxiliaries, whereas the fresh water in tanks and in the boilers necessary for the steam equipment weighs nearly this amount aside from the weight of the steam engine, boilers, etc. The fuel consumption will be decreased from 20 tons of coal to 3½ tons of oil per day. This is assuming that the owner takes out the steam deck machinery and installs Diesel-electric drive.

CURRENT REVIEWS

The Marine Power Plant. By Lawrence B. Chapman, Professor of Naval Architecture, Lehigh University, 320 pages, 1922. This latest contribution to engineering literature adds a volume which is written in exceedingly understandable language and affords a comprehensive idea of the layout and function of the various types of marine machinery. Emphasis is laid upon the thermodynamic and economic features of each and in the chapter devoted to the Diesel-engine the advantages of this newer power are well brought out. In view of the rapidly increasing importance of the motorship, and in view of the many books covering all phases of marine steam engineering, it seems a little strange, knowing the author's full recognition of the merits of the Diesel-engine and his advocacy of this most economical power which has likewise proved to be thoroughly reliable, that he should have devoted but one chapter of the nineteen to the Diesel-engine and only touched on it in others. Possibly he had in mind the much greater steam tonnage now existing, rather than catering to the immediate future.

The latest Diesel-engine catalogue of the Werkspoor Works, Amsterdam, Holland, has just been received. It is a comprehensive little work and as it contains illustrations and discussions on various features of the design of the engine it will be found of more than usual interest to engineering and shipping men. We note that instead of comparing this engine with other Diesel designs the Company has devoted the space to comparing the engine with its older competitor, steam machinery. This is a sound policy and one that could be followed in the interests of the Diesel-engine industry at large, as every good design of Diesel can stand on its individual merits. Controversial comparisons with other makes and types should be avoided at all times and a united front presented to the more formidable competitor. Copies can be secured from the American representative, Woolworth Bldg., New York City.

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MOTORSHIP

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TWO 21,000 TONS DIESEL-DRIVEN ORE-CARRIERS

Vessels to Be Built in Germany for Swedish Owners, for Carrying Ore from Chile to the United States for Bethlehem Steel Interests

JUST after we closed for press with our last issue, cable advice was received from one of our European correspondents to the effect that Axel Brostrom & Sons of Göteborg, Sweden, had ordered two ore-carrying motorships of 21,000 tons d.w. each from the Deutsche Werft, Hamburg, Germany, to be used by the company for carrying ore from Chile to the United States on contracts with the Bethlehem steel interests. Both vessels are to be fitted with Diesel engines. Considerable significance is attached to this order because it would infer that by building and operating economical motorships, a Swedish ship-owning concern can carry freight from South America to the United States at lower rates than the Bethlehem Steel Company with all its vast shipbuilding, ore mines, steel construction, and ship-operating facilities. Otherwise, why should the contract for 200,000 to 300,000 tons of ore transportation a year be placed abroad for a period of twenty years, even though it is reinstatement of a pre-war contract?

The Bethlehem Steel Company has its own transportation subsidiary, namely the Ore Steamship Company, which operates the motorship CUBORE, which was built a few years ago and installed with the first of the Bethlehem-West two-cycle type valve-in-head-scavenging Diesel engines, which engine, incidentally, has higher cylinder output than any single-acting Diesel-engine in our merchant ship service; namely, 584 i.h.p., the engine itself having an output of 3,500 i.h.p. from six cylinders 25½" bore by 48" stroke. It will be remembered that it was the intention of the Ore Steamship Company to have four Diesel-driven ships of 20,000 tons each, but before placing the contract the machinery arrangements were changed to geared turbine drive. These vessels are now in service and two more are under construction on the Pacific Coast. The two new Diesel ships will be the largest motor-freighters yet ordered and also will be the largest ore-carriers of any type in the world, so will be vessels of considerable importance. They each will be propelled by twin A.E.G.-Burmeister & Wain four-cycle Diesel engines of 3,000 i.h.p. each. At the head of the Axel Brostrom Company is Mr. Dan Brostrom, who is also an important factor in the Swedish East Asiatic Company, the Swedish-American Line, and many other big Scandinavian shipping interests.

WHAT IS A DIESEL ENGINE?

IN a recent letter to the *Engineer*, of London, H. Riall Sankey refers to Dr. Rudolf Diesel's British patent specification No. 7421 of 1892, which Mr. Sankey states claims the use of all kinds of fuel—solid, liquid and gas—and covers an engine with the following characteristics and asks which if any of these characteristics are found in the Diesel-engine of to-day.

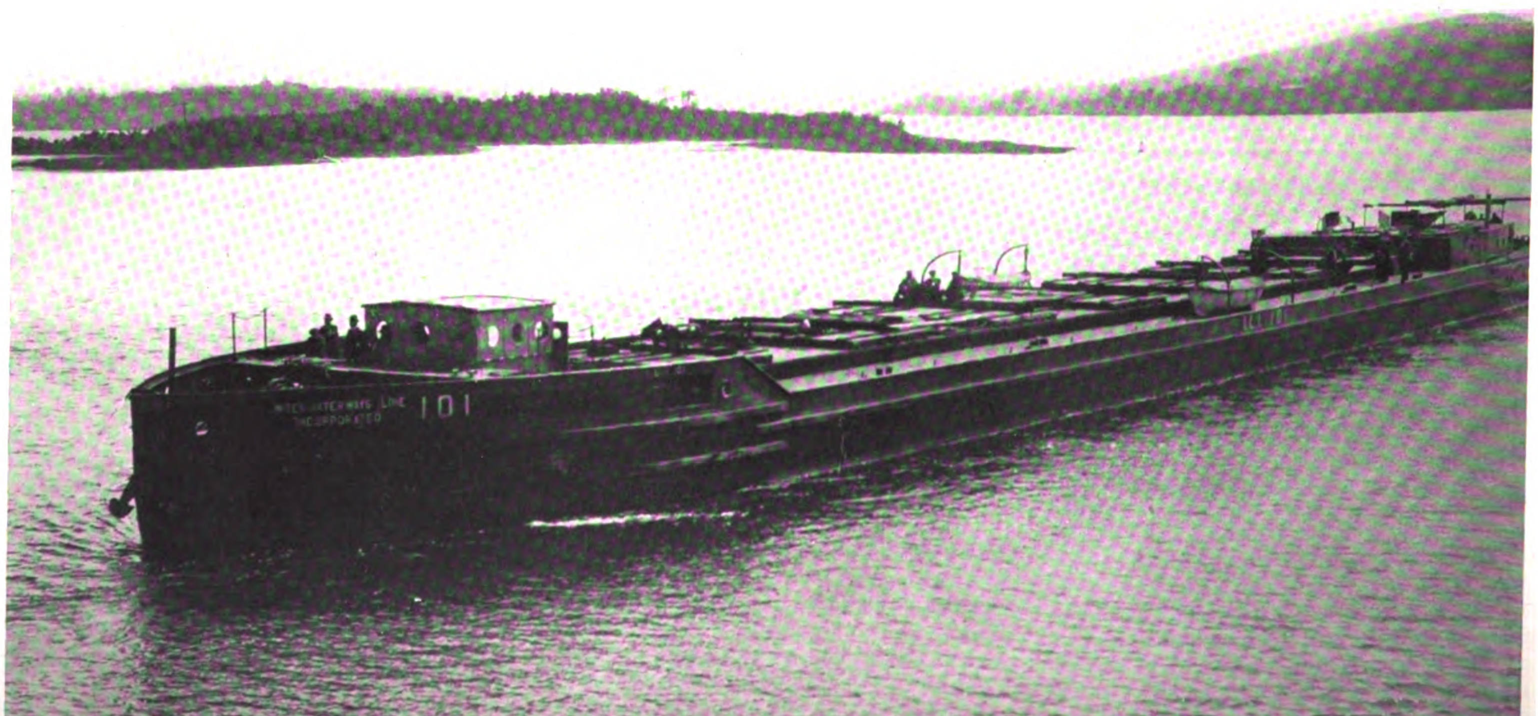
(1) Compression of pure air, or of pure air mixed with inert gas, to such a pressure that the temperature produced by the compression is far greater than the ignition temperature of the fuel.

(2) Admission of the fuel at the turn of the stroke, this admission being gradual and at a regulated rate so that the temperature during combustion will not exceed the compression temperature.

(3) Expansion to be sufficient for the exhaust to be at about atmospheric temperature so that the exhaust gases carry away only insignificant quantities of heat. By special arrangement the exhaust temperature can be made lower than the atmospheric temperature and can be used for refrigerating purposes.

(4) No artificial cooling of the cylinder walls is necessary; but on the contrary, they should be lagged to protect against loss by radiation of heat.

However, for Mr. Sankey or others to quote this particular patent will only tend to create confusion because, as we have previously indicated, the true Diesel cycle as now world-widely used is not according to the master patent of 1892 referred to by Mr. Sankey, but according to the second engine that commenced its four years' test in 1896 and which had air-injection of fuel, the original engine having airless injecton, and only ran a few revolutions on coal dust



One of the fleet of grain-carrying motorships operating on the New York State Canal. They are all propelled by oil-engines built by the Pacific Diesel Engine Co. of Oakland, Cal.

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when it blew the indicator to pieces. As regards the four claims in the patent of 1892 we may make the following remarks:—Claim No. 1 may be considered as accurate. Regarding No. 2, there is pressure-rise after the start of combustion, but No. 3 failed of accomplishment while No. 4 also failed on account of the failure of No. 3.

It is MOTORSHIP'S opinion that the true Diesel cycle is as follows:

(a) Compression of pure atmosphere to a degree that the temperature produced is adequate to the inflammation and combustion of the fuel.

(b) Injection of fuel at such a rate that the burning proceeds without rise of pressure on combustion space. (This condition is not realized with absolute precision, there always being a slight rise of pressure when the fuel begins to burn.)

(c) The injection of fuel by air-blast that produces turbulence needed for good combustion. (This is essential but not distinctive or exclusive to the true Diesel cycle.)

While an oil engine is or is not of the Diesel type according to its design, if it is desired to split hairs it may be said that any engine, the operation of which does not exactly conform to the foregoing three features, is not a true Diesel engine. However, during recent years development has been rapid and, many oil-engines, while based on the true Diesel cycle have been modified in several respects, but nevertheless may reasonably be termed Diesels or of the Diesel type, including several of the high-compression airless-injection designs.

Allowing a little latitude, any heavy-oil engine that relies upon the heat caused by compression of atmosphere for the ignition of the injected fuel is virtually a Diesel engine. That is what the inventor really had as his ultimate objective.

"MOTORSHIP'S" NEW ADDRESS

Will all our readers kindly take note that the business and editorial offices of MOTORSHIP have been moved to 27 Pearl Street, New York, just off Whitehall Street, right in the heart of the shipping district. From now onwards all correspondence should be sent to the new address.

SHIPPING BOARD HAS $25,000,000 FOR MOTORSHIP CONSTRUCTION

DOMESTIC shipowners can borrow money from the U. S. Shipping Board at two per cent for the construction of new motorships under Section eleven of the existing Shipping Act, **and the Board has that amount available at the present time** recovered for that purpose from last year's liquidation. This was made clear by Chairman Lasker in a letter to Senator Wesley L. Jones, copy of which we have before us. An equal amount may be put aside each year for five years, but unfortunately it is not possible to utilize the fund for conversion of existing useless steamers to economical oil-engine power. The proposed new shipping law will make a total of $125,000,000 available as quickly as it can be absorbed from liquidations, and the fund will also be used for converting steamships to Diesel and Diesel-electric power.

In his letter to Senator Jones Mr. Lasker states that he is sorry that no application from anyone has been made for any loan out of the Construction Fund, and that it is most discouraging that the Board has no such application, for it is utterly essential to the preservation of the art of shipbuilding in our country that American shipyards be stimulated. It is the hope and belief of the Board that if the new bill does pass applications for loans will result **and that there will be constructed types of ships which we, with all our ships, are so sadly lacking.**

It has now been generally accepted among shipping men, and incidentally has been made quite clear by members of the Board that except in instances were ships to be built are higher powered than is practical with the existing limits of oil-engines the Loan fund can only legally be used for motorship construction and cannot be made available to shipowners of the construction of vessels **less economical in type** than such successful American ships as the WILLIAM PENN, CALIFORNIAN, MISSOURIAN, KENNECOTT and H. T. HARPER. In section eleven the following clause appears . . . **"such vessels shall be equipped with the most modern, the most efficient, and the most economical machinery and commercial appliances."** While ample and absolutely reliable figures have been released by American and foreign shipowners indisputably showing that oil-engine power is the most economical type of machinery for both long and short distance voyages, no authentic figures have ever been made public showing that a coal-burning or oil-fired steamer has proved more economical than a Diesel-driven motorship. These conditions will apply also to the proposed Act when made law, with the additional clause empowering the Loan fund to be used for the conversion of steamships to motor power.

OIL-ENGINES IN THE YACHTING FIELD

IT is not inconceivable that within a very few years the steam-yacht of the millionaire yachtsman will have disappeared from the seas. The Diesel engine has sounded the note which announces another change in yacht types; from sailpower to steam and then to gasoline engine-power has been the history of yachting development. Now both steam and gasoline-power must give place to the more economical oil-engine. There is no escape from this development because it is founded upon the basic laws of economy which exert such powerful influence upon man that they simply must rule. Many instances may be found in MOTORSHIP'S pages of extremely wealthy men installing oil-engines in place of other power in their luxurious pleasure craft; these men could afford to operate steam or gasoline yachts at many times the cost of the oil-engine power they install; however, the psychological influence of the economical trait in human nature impells them to adopt the most economical power. As compared with a steam-yacht they can make their Diesel motor-yacht smaller by twenty-five per cent. yet affording equal or better accommodations, the crew (always a difficult problem to contend with), is reduced, eliminating the least desirable elements—the firemen and smoke—also the Diesel-yacht is generally more handy, cleaner, more attractive in every way. As compared with the gasoline-engine driven yacht the safety feature of the Diesel craft when large supplies of fuel are carried cannot be overestimated.

A Diesel-yacht can be operated at very low cost over a long cruising-radius, making it possible to attain fairly high speed at but a fraction of the fuel-expense which high speed always means with a gasoline-powered boat. For instance, a 130 ft. Diesel-driven yacht travels 15 nautical miles in one hour on a fuel-consumption of 14¾ gallons of fuel-oil costing 4¼ cents per gallon, or 63 cents per hour, while two 200 h.p. gasoline-engines giving the same speed would consume 35 gallons of gasoline costing 25 cents a gallon, or $8.75 per hour. Considering this low cost of operation the owners of such a yacht can enjoy lengthy cruises without the nuisance of re-fuelling which a gasoline installation could never afford.

It is a mistake for opponents of Diesel power for yachts to argue that they vibrate uncomfortably. Every power-driven craft vibrates when driven at revolutions at which the natural vibrations of the hull and engines synchronize. We must simply avoid driving at that period in the revolutions of the engines at which this synchronism appears. As experience is gained with Diesel-yachts all the minor details will be perfected and they will equal and even surpass the superceded types.

OUR COASTWISE TONNAGE

IT is only the matter of a few years before at least fifty per cent. of existing American steamships will be converted to oil-engine power or replaced by new motorships. There is a huge tonnage in the Atlantic coastwise and coast-to-coast services alone owned by the Agwi, Munson, American-Hawaiian, Nawsco, Isthmian, Clyde, Mallory, Ward, Porto Rico, Morgan, Williams, Pacific Mail, Admiral and Dollar lines which should form the objective of all domestic Diesel-engine builders, as well as Pacific Coast lines and in addition to hundreds of smaller craft owned by minor companies. In some of the coastwise routes business is quiet and so economies in operation are of the greatest importance. We believe that in many cases the savings in fuel and labor and the additional cargo capacities gained warrants the additional cash-investment necessary to bring many of these vessels up-to-date. Six Atlantic Coast lines mentioned among those above operate 85 passenger and freight ships aggregating 317,000 tons deadweight, as well as a big fleet of new Agwi tankers which for the most part are laid up. The potential possibilities of future business are sufficient to warrant engine manufacturers concentrating their energies and co-operating with the superintendent-engineers and executives of the Lines with a view to working out the costs of conversion or replacement and ascertaining the resultant economies in service. MOTORSHIP'S service in this connection are available.

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Propeller Efficiency for Motorships

Details of a New System of Design and Calculation of Screw-Wheels

By S. E. SLOCUM, Ph.D.*

UNDOUBTEDLY the question of propeller efficiency is the most important factor in marine development at the present time. Evidently the work of the naval-architect in designing the hull must be coordinated with that of the marine-engineer in designing the power plant through the medium of the propeller. In fact, the efficiencies of hull, propeller, and power plant are so closely and intimately related that it is impossible to determine any one element except in its relation to the other two. Hull efficiency depends only in part on the resistance a vessel offers to motion through the water. A far more important consideration from the standpoint of propulsion is the location of the propellers and the form of afterbody, which determine the wake and thereby the flow of water entering the propeller.

As regards the power plant, it is obvious that propeller design must develop in accordance with the requirements of new types of marine engine. The increase in speed of revolution which has accompanied the development of the modern marine engine is of course the most important factor affecting the propeller. The wide range of speed requirements existing between the reciprocating steam engine, the Diesel oil-engine, and the steam or gas turbine must be met by corresponding modifications in propeller design. The design of medium and high speed propellers of high efficiency adapted to modern power plants is for this reason the most important field of research in marine engineering. Hull efficiency and engine efficiency can only be realized when their connecting link, namely the propeller, satisfactorily fulfills the mutual conditions they impose.

Until recently the development of the screw propeller has been based mainly on experiment. One feature only has been developed in accordance with rational engineering practice, namely, its strength. The pitch of the propeller, the contour of the blade, the blade area, and blade cross section have all been determined experimentally from the actual performance of certain combinations of standard types of hull and propeller. Propeller design has been standardized in accordance with such data, the result being of course that when we are concerned with standard types of hull and power plant, the propeller can be laid out with reasonable assurance that it will show a satisfactory efficiency.

At the time when this method has reached its limit, and the development of new types of hull and engine has opened up a new speed and power range for propellers, a new method of propeller design has become available, based on a rational analysis of propeller action. For a number of years scientific work has been carried on in various countries, having for its purpose the determination of the physical laws which govern the motion of a body through a fluid. As the result of this work, a sound engineering basis has been laid for the calculation of propeller action. Like all great natural laws, the final results as applied to propellers, are surprisingly simple. The subject is too technical to be presented briefly, but certain outstanding features of this method of rational design may be mentioned.

When a fluid flows past an object immersed in it, such for instance as the section of a propeller blade, it follows certain definite stream lines. This stream line flow can be readily analyzed into three components, one consisting of a flow parallel to the chord of the contour considered, a second flow perpendicular to this chord, and a third flow completely encircling the contour, and for this reason called the circulation.* This circulation flow around the blade is a very important fact. Among other results, it enables us to determine the proper profile for the blade instead of assuming it to be elliptical, as formerly It is a fact of common observation that when a propeller is working, a row of spiral vortices runs off the tips of the blades; these can usually be seen strung out behind the propeller for some distance. These are produced by the circulation flow around the blade, which, owing to the form of the blade, does not disappear when it reaches the tip, but creates a series of vortices.

Being given the fact of this circulation flow, it is possible to so determine the equation of the blade contour that the circulation shall die out at the tip, thereby avoiding the loss of energy represented by the formation of vortices. This condition is of such a nature as to give not only one, but a whole series of similar contours. All of these contours of course are represented by the same type of equation; that is, in mathematical language, they all belong to the same family of curves.

> Finality in propeller design is still a long way off, and correct screws are rarely produced until after the vessel has run trials, but methods of calculation are rapidly improving, and the article on this page describes a very promising system. The efficiency of many motor-craft have been impaired by unsuitable propellers, so Professor Slocum's discussion probably will prove to be of great value.

In Admiral Dyson's method of propeller design he has standardized on one particular type which he calls the "basic" propeller. It is interesting to note that one of the several types of blade contour which have been developed in accordance with the circulation theory conforms very closely to Admiral Dyson's basic type, indicating that his experimental results run parallel to those based on rational analysis, forming a special case of the general theory. It is well known that a propeller is very sensitive to changes in the form of its blade tips, a fact also clearly indicated by the rational method of design, which enables us to depart from one fixed "basic" type and yet determine the new blade contour with assurance as to its performance.

It is commonly assumed that a propeller should be of constant face pitch for greatest efficiency. Some propeller manufacturers even advertise this feature of constant face pitch as a guarantee of the merit of their design. In a propeller designed in accordance with the circulation theory, however, the face pitch is not constant. This result is also confirmed by the well-known fact that blade thickness increases the effective pitch of a propeller. In other words, in an ordinary propeller of constant pitch, as the blade sections increase in thickness towards the hub, the effective pitch of the propeller also increases, with the result that the propeller is of actually decreasing radial pitch. In the method of design based on circulation flow, the pitch varies with the radius according to a definite law, so that while the face pitch is not constant, the effective pitch is very nearly so.

The form of cross section of the blades of a marine propeller has received very little attention. The commonly accepted practice is to make the so-called "driving face" flat, and the dorsal face the arc of a circle, the height of this arc, or camber, being determined by conditions of strength. The analysis of stream line flow past a cross section of this type, however, shows that it creates either a region of stagnant water on the back of the blade, which travels with it, or sends off a succession of vortices from this region. As such action is closely related to cavitation, the point at which cavitation enters can be materially raised by proper design of the dorsal face of the blade. The correct design for blade cross section is a very intricate mathematical problem, and its solution is limited by requirements of strength, but certain outstanding principles are well established, and enable the cross section to be laid down on correct principles. In order to avoid cavitation at high speeds it is common practice to increase the area of a propeller considerably above that required for propulsion, provided cavitation was suppressed. Such increase in area, however, is accompanied by decrease in efficiency. If, therefore, the dorsal face of the blade is so designed as to materially raise the point of cavitation, it has the effect of permitting the use of a more favorable area ratio, with a consequent increase in efficiency.

Every branch of engineering must pass through an experimental stage in the course of its development. But in every exact science, the experimental data accumulated, eventually takes form in accordance with the natural laws which govern the subject. It then becomes possible to attack the theory underlying the subject and develop the mathematical laws on which it is based. This stage of development has now arrived in propeller design. As long as propeller design was empirical and based solely on performance, it was inevitable that it should be more or less rigid and limited in application to standardized types of vessels and power plants. The method of design based on the circulation flow does not contradict any of the results of experiment. On the contrary, it confirms in a very remarkable manner the chief characteristics of the most successful propellers, with the advantage that it can be extended indefinitely to meet new conditions as they arise. Our experimental data, then, instead of restricting our range of applications, can be utilized to determine the empirical constants required to supplement the theory, and which are always necessary to make the analysis of any engineering problem practical as well as rational.

Although the thermal efficiency of a Diesel engine is comparatively high, its mechanical efficiency is low as compared with steam, particularly if the compressors, pumps, etc., are driven off the main engine. To better this low efficiency, it is important that the propeller should be direct connected, and designed with special reference to Diesel power. For this purpose the rational method offers a great advantage over the empirical methods now in use, and if fully utilized, it must become an important factor in the development of Diesel power.

* Mem. Amer. Soc. Naval Eng., Consulting Engineer, with N. W. Akimoff, Philadelphia.

*See article by the author, Jour. Soc. Naval Eng., Vol. XXXIV, No. 3, Aug., 1922.

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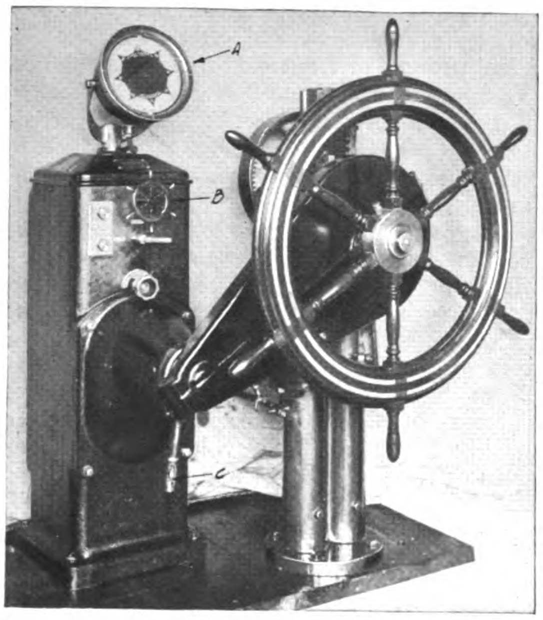
Remarkable Navigating Instrument

The Sperry Mechanical Quartermaster Supercedes Steering by Hand

MARKED advance in the invention and perfection of instruments for the navigation of ships has been made in recent years, notably through the genius and perseverance of Elmer E. Sperry. When one looks back a few years to the era when all steering was done by hand through steering-wheels directly connected to the rudder, involving in heavy weather the necessity of putting two or three men on the wheel, and when we look back to the simple compass easily affected by the slightest magnetic influences, often so far from correct that it resulted in the loss of many a fine vessel, one marvels at the progress which has been made. In place of inaccurate instruments and hard labor we now find the utmost accuracy and precision in the navigational instruments and so we are perhaps not greatly surprised that ships may be steered without a man at the steering wheel.



Sperry Mechanical Quartermaster. A—Repeater Compass; B—Wheel for hand setting of course; C—Clutch for disconnecting mechanical quartermaster

Such a revolutionary step in the operation of ships must interest all, for to say the least, it seems somewhat uncanny that a large ocean-going vessel should safely navigate changing courses by mechanical means alone. However, the Sperry Mechanical Quartermaster has steered ships on 4,000 mile voyages, making all courses and landfalls desired. So satisfactory has this service been that the master of a vessel on which this equipment was installed stated in his report that it "steered all the various courses around the Florida reefs and across the Gulf of Mexico without any variation in course. It steered a truer course than any wheelsman could steer." While hand steering in connection with the Sperry gyro-compass has become quite general because of its accuracy this latest product of the Sperry organization goes even farther and eliminates the slight inaccuracies of hand-steering by providing automatic-steering by gyro-compass.

This new equipment is by no means a recent thought, but has been in a state of development for several years, progress being temporarily halted during the war but brought to perfection in recent months. The illustrations provide a general idea of this remarkable instrument.

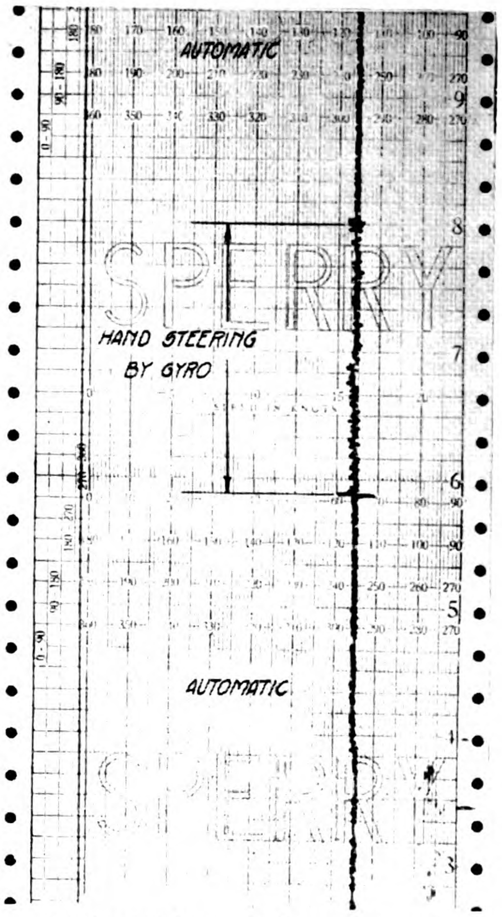


Chart showing actual record of steering both by hand and Sperry Mechanical Quartermaster

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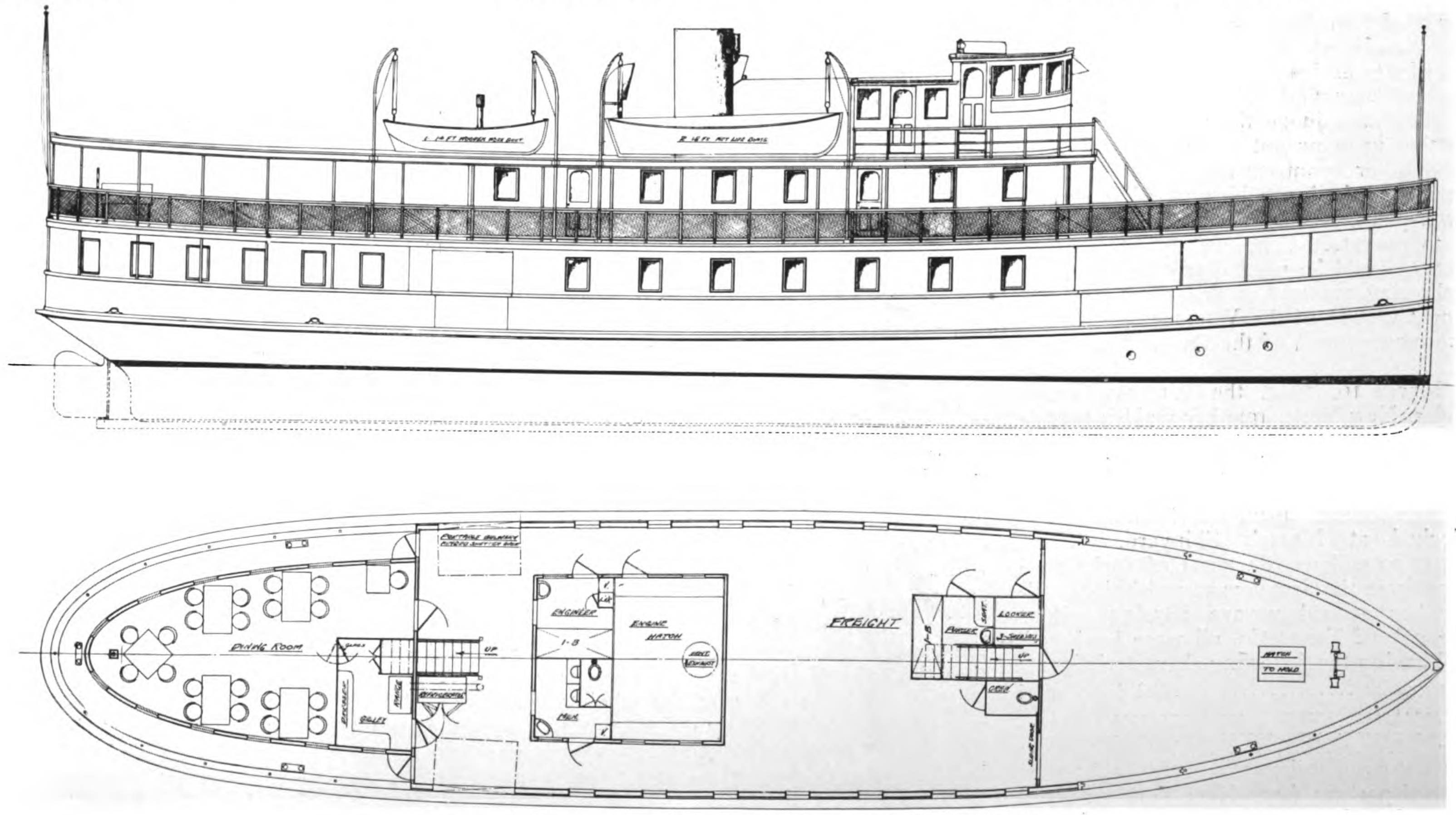
NEW MOTOR FREIGHT AND PASSENGER BOAT FOR FLORIDA SERVICE

Considerable interest attaches itself to a new oil-engined combination freight and passenger craft now being built for the Adams Boat Line of Sarasota, Florida, by the Murnan Shipbuilding Co. of Mobile, Ala., from designs by Cox & Stevens. She is of a type which MOTORSHIP has constantly recommended for our coastwise and harbor service, one which is infinitely more economical and more efficient than the small steamer of this size which operates in too great numbers. This boat illustrated is being constructed for service between Tampa and Manatee and will be delivered in November. She is of the following dimensions:

Length over all	120′ 0″
Length water line	114′ 0″
Breadth over planking	24′ 2″
Depth	8′ 0″
Draft	5′ 0″

She will be equipped with two 100 h.p. Kahlenberg surface-ignition oil-engines which will drive her 12 miles per hour. It will be noted that the space available for net freight and passengers is maximum, no great area of hull being lost to boiler, fire and engine rooms as in case of the small steamer. In addition to space saving there is a considerable saving in weight of machinery and fuel, important in a shallow-draft boat.



General Arrangement Plan of the Adams Boat Line Motorship

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Second World Voyage of the "William Penn"

U. S. Government's Motorship Improves Upon Splendid Record of First Voyage

AGAIN the Shipping Board's first and only motorship WILLIAM PENN has docked in New York after successfully completing a world-voyage. Once more has been demonstrated the fact that America can operate motorships in world trade on a par with European owners and that American Diesel-engineers are efficient. Both voyages have been made without an involuntary stop of the engines and no repairs have been necessary either during or upon the completion of either voyage; such items as grinding-in of valves, renewal of packing, taking-up on bearings or bolts, etc., have been the sole adjustments made by her engineers. The WILLIAM PENN has always been ready to sail as soon as cargo was loaded or discharged, her machinery never failing.

It is hardly possible that readers of MOTORSHIP are unacquainted with the particulars of this vessel; however, we will repeat them at this point for memory refreshment purposes. She was built by Pusey & Jones, and equipped at the Cramp shipyard with Burmeister & Wain built Diesel engines.

Length (O. A.)	455' 0"
Length (B. P.)	445' 0"
Breadth (M. D.)	60' 0"
Depth (M. D. to S. D.)	36' 8"
Draught (loaded)	28' 4¾"
System of Construction of Hull	Isherwood
Power (indicated)	4,500 h.p.
Power (shaft)	about 3,500 h.p.
Fuel-capacity (incld. 57 tons in settling tank)	1,343 tons
Total cubic capacity for cargo below decks	555,320 cu. ft. (bales or 627,830 cu. ft. grain
Propellers (bronze twin four-bladed)	13' 6" dia. by 11' 9" pt.
Propelling engines	Burmeister & Wain 6-cylinder, four-cycle
Cylinder bore	740 mm (29.134")
Piston stroke	1,150 mm (45.275")
Engine speed (designed)	115 r.p.m.
Total number engine-room crew	14 men
Daily fuel-consumption in port	½ ton
Daily fuel-consumption at sea	13½ tons

It is evident from these dimensions and tonnage figures that the WILLIAM PENN is a fair example of the great majority of American cargo vessels except that her Diesel-power makes possible greater earning capacity in the form of increased speed, cargo-capacity and decreased cost of operation. Therefore, owners of steamships of the WILLIAM PENN'S dimensions may find in her a measure by which they may judge their vessels, remembering that in many out-of-the-way places in this and other countries are whole fleets of steamers, very similar to this motorship, except in power-plant, laid-up because they cost too much to operate. Consequently, steamship-operators should be particularly interested in the following account of this second round-the-world voyage of the WILLIAM PENN under the management of the Barber Steamship Line.

On March 19, 1922, the WILLIAM PENN arrived in New York from her maiden round-the-world voyage. She remained at the Barber Line dock in Brooklyn 33 days discharging ballast and loading cargo preparatory to her second voyage, during which time she was dry-docked at Morse's Shipyard. There were 24,820 gallons (84 tons) of fuel-oil remaining from the first voyage and before sailing on her second voyage 287,625 gallons (978 tons) of Texas Co. oil were bunkered, this oil having the following characteristics:

Specific gravity	24.2 deg. Baumé
Flash	194 to 198
B. T. U.	19,000
Sulphur	6/10 of 1 percent
Bottom water and sediment	6/10 of 1 percent

Upon departure from New York on April 22, 1922, the WILLIAM PENN was fully loaded with cargo consisting of the following: Steel, tinplate, machinery and general cargo.

Fair weather was experienced on this run of 246 miles which she covered at the rate of 11.55 knots on a mean draft of 28' 8", to Norfolk, Va., where considerable additional cargo was loaded, this consisting of cotton. The run to Panama was made at the rate of 11.4 knots over a distance of 1,769 miles; her draft on this run was increased to 29' 2" and the average i.h.p. was 4,413. During this trip the sea was comparatively smooth and light to moderate winds prevailed.

Arriving at Panama on the morning of May 1st, after traversing the Canal, the WILLIAM PENN immediately laid her course for Honolulu where she arrived May 18th, after a non-stop run of 4,718 miles, which was made at an average speed of 11.4 knots, the engines developing 4,347 i.h.p. at 110 r.p.m. on a consumption of fuel of 98.4 barrels per day, equal to 0.296 lb. per i.h.p. hour.

As was the case in the first voyage, fuel-oil was bunkered at Honolulu, 179,781 gallons (611 tons), thus totaling 492,226 gallons (1,673 tons) of bunker including that remaining from the previous voyage. The oil bunkered at Honolulu was supplied by the Standard Oil Co. of California, and was of the following characteristics:

Specific gravity at 60 deg. F.	28 deg. Baumé
Flash (open cup)	194 deg. F.
Water	trace
Viscosity at 70 deg. F.	45

She remained at Honolulu somewhat over three days and on May 22nd departed on the 3,449 mile trip to Yokohama, experiencing fine weather for this run which was made at an average speed of 10.66 knots, which slightly decreased speed over the previous portion of the voyage is accounted for by the fact that she was loaded deeper with bunker-fuel and the engines were not developing as much power, being run at only 105 r.p.m.

At Yokohama the ship was visited by high officials of the Japanese Navy, and Chief-Engr. Olson was literally bombarded with questions of every sort regarding the details and operation of the machinery. Part of the cargo was discharged at Yokohama and at Kobe, Japan.

The WILLIAM PENN arrived in Shanghai, China, on June 25th, after satisfactory run at a speed exceeding 11 knots average, the h.p. having been increased by speeding-up the revolutions to 110 r.p.m. Certain cargo was discharged at Shanghai, and during this process opportunity was given to American and other business men to visit the ship. An of-official report to the Board made by Engineer Olson will be published in our December issue.

Leaving Shanghai July 1st, the WILLIAM PENN made the run of 771 miles to Hong Kong where she arrived on July 4th and her American crew celebrated Independence Day with as much enthusiasm as did Americans in this country. From Hong Kong her course lay to Manila where she ended the first half of her trip around the world on July 7th, remaining six days to load cargo for the return voyage.

From Manila to Cebu, P. I., and Singapore, the voyage proceeded without incident except that the only time the ship's engines were stopped while *en route* on the whole voyage was on July 20th when, in order to await daylight before passing through the Narrows, she lay to. Complete information on the voyage is contained in the extract copied directly from the log of the WILLIAM PENN which will be given next month together with the official report and our readers will be interested to note how uniformly consistent her engines operated, the revolutions, fuel consumption, and power developed being quite along the same average throughout the voyage. In fact, during one run in the East the WILLIAM PENN was obliged to slow down in order to remain near the steamship EASTERN KNIGHT, which was experiencing serious machinery trouble and was liable to require assistance.

No trouble was experienced with the machinery of the WILLIAM PENN at any point of the voyage and the ports of Singapore, Suez, Port Said, Marseilles, Bilbao, and London were entered, cargo discharged, and the vessel proceeded from port to port with clock-like regularity. From London she proceeded to Hamburg, where, in addition to discharging the remainder of her cargo, she loaded a small amount of cargo and some ballast for her trans-Atlantic trip.

Leaving Hamburg September 26th she encountered gradually increasing wind and sea which, between the 30th of September and October 5th, increased to hurricane conditions and the ship rolled quite heavily. However, it is interesting to note that Chief-Engineer Olson reports that in spite of the extremely bad sea running, the Aspinall governor so quickly controlled the revolutions of the engines as the propellers came out of the water that the progress of the vessel was remarkably smooth. Whereas a steamer which had come through the same conditions in the near vicinity of the motorship was so badly shaken up that she was forced to go to the repair yard upon reaching New York.

We went aboard the WILLIAM PENN as soon as she made fast to the dock in Brooklyn and her engine room was in perfect order as well as every part of her hold and machinery. In fact, she was ready to sail on a half hours notice, and in addition to being in A-1 condition, she had, upon reaching New York, (50.230 gal.) 170 tons of fuel oil in her bunkers, sufficient to take her from New York to Honolulu.

Upon reaching New York the WILLIAM PENN had travelled at sea 26,997 nautical miles, in rivers 637, a total of 27,634 nautical miles for the voyage, which was made at an average speed of 10.83 knots. The average slip of the propellers for the voyage was 13.2%. From time of arrival in New York from voyage No. 1, March 19, 1922, to date of arrival from voyage No. 2 on October 9th (this being date when she took a pilot aboard, which date is considered in the log as date of arrival) is six months, 21 days. For the voyage the total running time was 103 days, 18 hours, 56 minutes with 97 days, 14 hours, 6 minutes' time spent in port. Using D. T. E. Vacuum oil the consumption of engine oil of heavy medium grade at sea was 416 gallons, of extra heavy-grade cylinder oil, 1,060 gallons and of heavy compressor oil, 260 gallons; in port, 125 gallons of heavy medium, 24 gallons of extra heavy cylinder oil and 236 gallons of heavy compressor oil were consumed. This consumption of lubricating-oil is not much more than that used by a steamer.

Assisting Chief Engineer Oscar Olson in the operation of the WILLIAM PENN'S machinery are Everett N. Edes, 1st Asst.; Otto A. Horn, 2nd Asst.; JamesN. Allan, 3rd Asst., and Theo. Rasmussen, 4th Asst. In a great measure the successful voyage of the WILLIAM PENN is due to the Chief and his men, not to overlook the navigation work of Capt. R. H. Wright and his officers, to whom credit is also due.

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Shallow Draft Diesel-Electric Tug for U. S. Engineers

Ten Firms Bid for Construction of 100-Ft. Tow-Boat for River Service

BIDS on a new Diesel-electric tow-boat were opened on October 10th by the U. S. Engineer Office of the War Department, ten companies having submitted a total of 24 bids ranging from $89,000 to $192,445 for the complete vessel including machinery. The lowest bid submitted was that of the Charles Ward Engineering Co., Charlestown, Va., who offered Winton-Westinghouse propelling-plant with delivery in 200 days. The highest bidders were the Sun Shipbuilding Co., Chester, Pa., which concern was the lowest bidder recently on the four Diesel-electric dredges for the U. S. War Department. For the tug they offered Winton-Westinghouse equipment. Quickest delivery was offered by the Todd Shipyards Corporation, Mobile, Ala., who quoted 135 days and $97,850 with Winton-Westinghouse machinery. They also made four other bids with longer delivery and higher prices with McIntosh & Seymour, Nelseco, Worthington and Western oil-engines and General Electric equipment. No other makes of Diesel engines or electric equipment were quoted in the various bids.

The dimensions of the tug are as follows, and it will be noted that she is of the shallow-draft type for river service:

Length O. A.	119′ 3″
Length M. D.	100′ 0″
Breadth M. D.	23′ 0″
Depth	5′ 0″
Draft (Fully loaded)	3′ 0″
Power at Shaft	200 b.h.p.
Motor speed	600 r.p.m.
Stern Wheel speed	26 r.p.m.

The specifications call for twin two-cycle or four-cycle Diesel engines driving 100 k.w. generators, supplying current to a 200 b.h.p. 220-volt motor running at 600 r.p.m. and geared down to turn the pitman shaft at 26 r.p.m. through herring-bone gears made by The Falk Corporation, Milwaukee, Wis., or by the Fawcus Machine Co., Pittsburg, Pa., or equal. In addition to the main engines there is a 7½ k.w. gasoline electric generating set for the lighting, which is to be made by the Winton Engine Works, Allison Engineering Co., Buffalo Gasolene Motor Co., or the B. F. Sturtevant Co., or others if approved.

The stern wheel is 15′ in diameter, and the pitmans are to be of the usual Mississippi River type. Fire, bilge and sanitary pumps to be of the Northern Fire Apparatus Co.'s type, while the fuel-oil system is to be similar to that made by the Maritime Hydraulic Oil Service Co., 2 Stone St., New York, the bunker capacity being 48 tons. McComb oil-strainers are named in the specifications. There will be a cold-storage room which must be given three coats of Valspar varnish. For fire purposes eight large Pyrene extinguishers are to be installed. Plumbing fixtures and fittings of A. B. Sands make will be installed, and there will be an Ideal-Arcola heater fitted for burning oil if practical or else coal. This heater has been installed recently on a number of motor-vessels. On the pilot-house there will be a 16″ 500 watt Crouse-Hinds electric searchlight.

We have before us drawings of this interesting motor craft, which the U. S. Engineers Office have courteously supplied. But, we are obliged to withhold publication until our December issue because of great pressure on space.

Three Diesel-engined motorships under construction at the Deutsche Werft, Hamburg

NEW GERMAN MOTORSHIP "ERMLAND"

REGARDING the motorship ERMLAND, trials of which were recently run, and which vessel has been referred to in MOTORSHIP on several occasions as having been built by Blohm & Voss for the Hamburg-American Line, she has a register of about 6,000 tons gross and makes the fourth new motorship to be completed for this well-known German Transatlantic Company since the war, all of which were built by Blohm & Voss. Her dimensions are as follows:

Length	450′
Breadth	58′
Depth	27′
Power	4,350 i.h.p.
Engine-speed	100 r.p.m.
Type of auxiliaries	Diesel-electric and steam

It is reported that a sister motorship to the ERMLAND has been ordered by the Hamburg-America Line, in addition to several other Diesel-drive vessels under construction, one of which being the ODENWELD now completing at the Deutsche Werft and referred to on page 783 of our last issue. The ERMLAND has twin Blohm & Voss four-cycle Diesel engines, 28.25″ bore by 51.15″ stroke. While these engines are of the single-acting type Blohm & Voss are said to be carrying on further development work in connection with two-cycle double-acting and four-cycle double-acting types of engines.

New motorship "Ermland," with the latest design of Blohm & Voss Diesel engines

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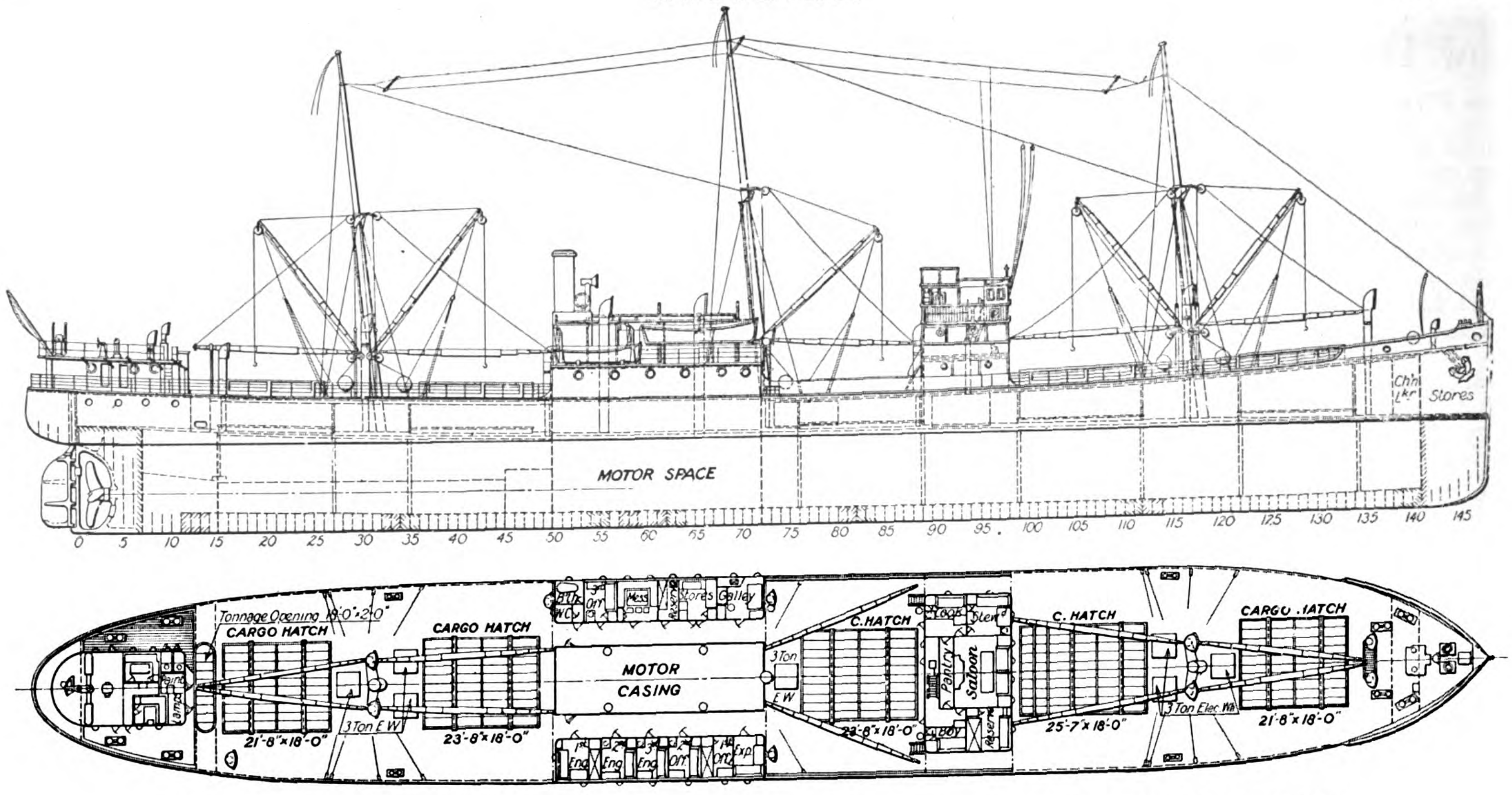

Profile and deck plans of motorship "Erland." Plans of a sister steamship were published on page 218, March, 1921

Tirfing Company's First Motorship

"Erland," the Second Swedish-Built Single-Screw Long-Stroke Götaverken-Burmeister & Wain-Engined Vessel Runs Trials

THERE are now two motorships of very similar name in service. One of these is the twin-screw ERMLAND built by Blohm & Voss for the Hamburg-America Line, and the other is the single-screw ERLAND built by the Eriksberg Shipyard and engined by Götaverken, for the Tirfing Shipping Company, which is one of the subsidaries of Axel Brostrom & Sons, headed by Dan Brostrom, the Swedish shipping magnate—which company has secured the contract to carry ore for the Bethlehem Steel Company from Chile to the United States, and which service will be maintained by two 21,000 tons motorships recently ordered in Germany by the Swedish concern.

The original name of the new Swedish ship ERLAND was TRINACRIA, having originally been ordered by the Swedish Lloyd and sold to the Tirfing Company. It will be remembered that comparison and scale drawings of this vessel and of the sister steamship HIBERNIA were published in MOTORSHIP for March, 1921, pages 218-219.

The ERLAND has been built at the Eriksberg Shipyard, Göteborg, and engined by Götaverken of the same city with the long-stroke slow-speed Burmeister & Wain Diesel type design. The Götaverken have followed the broad policy, also adopted by Burmeister & Wain and by the Wm. Cramp & Sons Ship & Engine Building Company, of supplying Diesel engines to other shipyards that have no facilities for constructing such engines. The ERLAND has been built to British Lloyds' highest class and to Swedish regulations, and is a shelter-deck vessel with a cruiser stern and with the machinery installation amidships. She has the following dimensions:

Deadweight-capacity	3,750 tons
Length b.p.	292'
Breadth (md.)	43'
Depth (md.) to Shelter deck	26'
Loaded Draft	19' 9"
Power	1,600 i.h.p
Engine and Propeller Speed	95 r.p.m.
Trial Speed	12.6 knots
Bunker-capacity	480 tons

The propelling engines consist of a six-cylinder Götaverken-Burmeister & Wain Diesel engine, 630 mm. (24.8032") bore by 1300 mm. (51.1814") stroke, turning at 95 r.p.m. For providing power for the auxiliary

Tirfing Company's new motorship "Erland"

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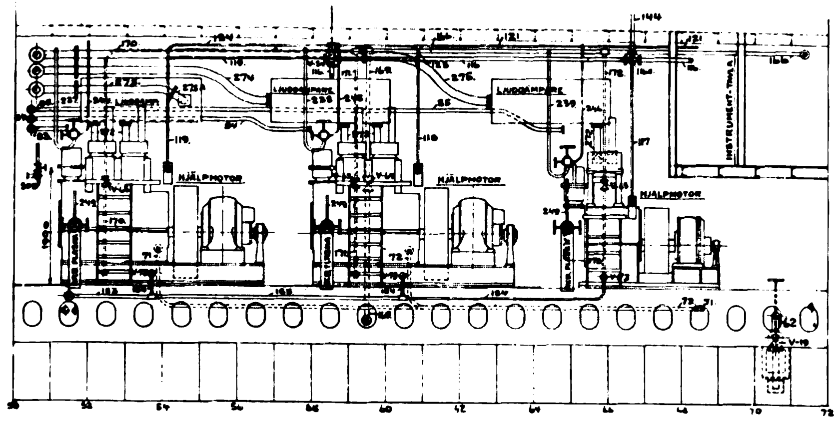
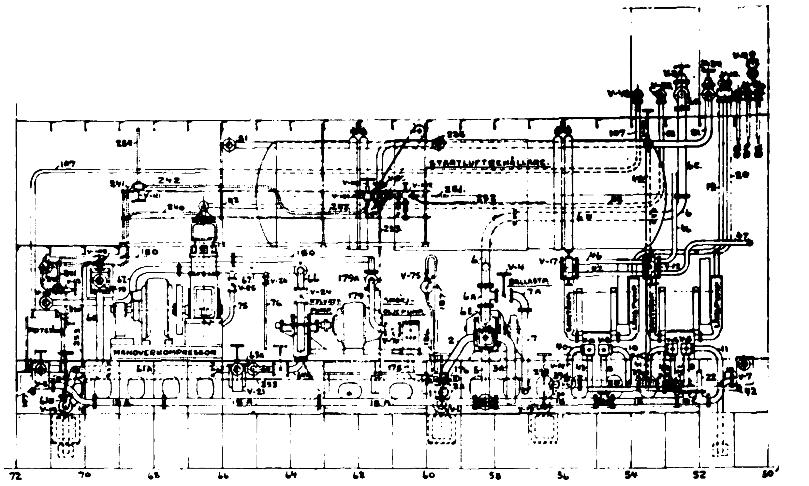




Arrangement of auxiliaries in engine-room of motorship "Erland"

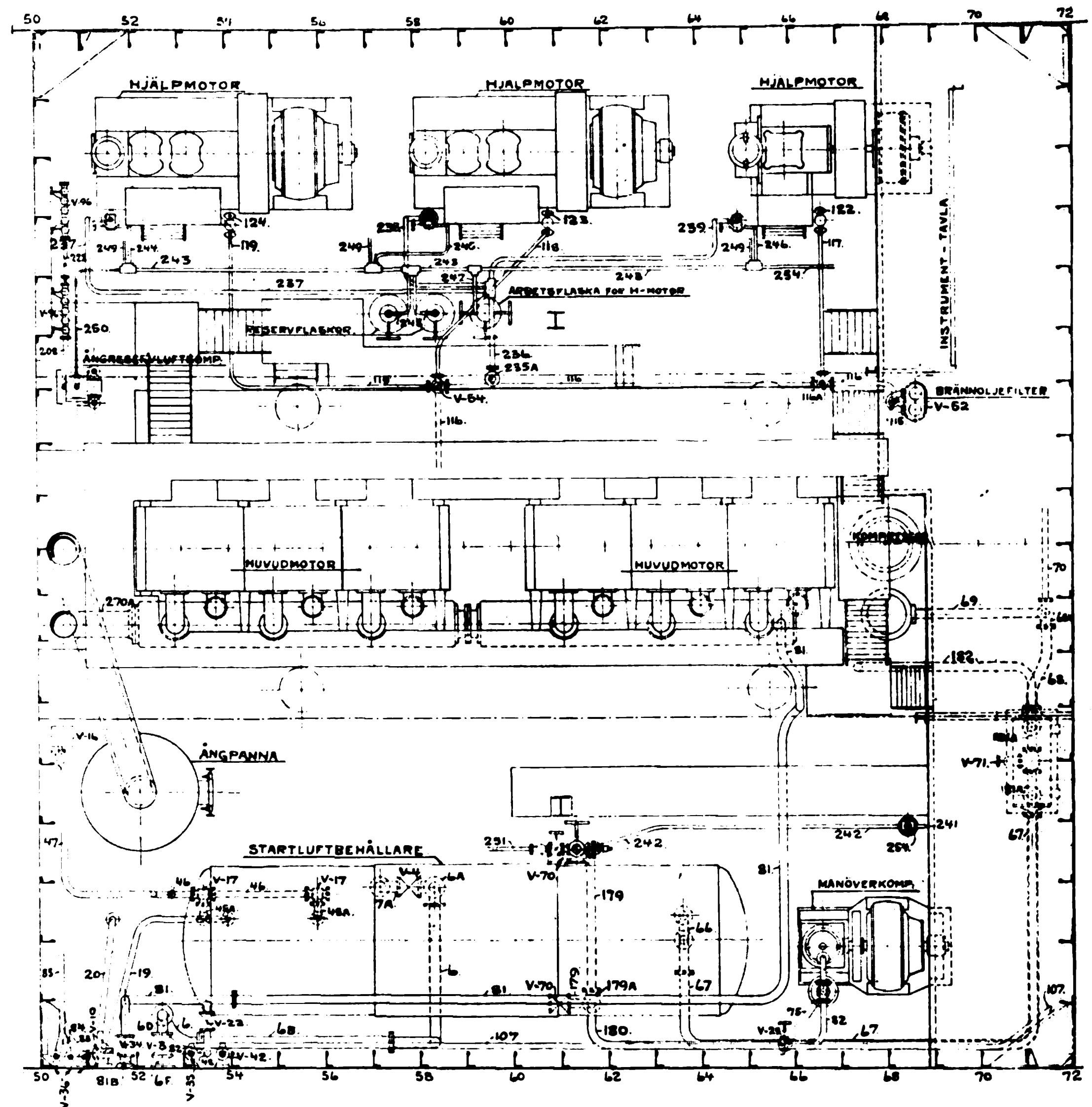
machinery there are two twin-cylinder Diesel engines and a single-cylinder Diesel engine, all driving generators which furnish the current for the winches, air-compressors, pumps, etc. There also is an oil-fired donkey-boiler for heating the ship and for operating certain emergency auxiliaries. When on trials the vessel attained a speed of 12.6 knots as a mean over 4 runs, the engine developing 1,660 i.h.p at 92 r.p.m The fuel-consumption worked-out at 130 grams per i.h.p. hour.

The ERLAND is a three-masted vessel and her fore and aft cargo holds are served by ten derricks and seven electric winches through five large hatches. There is a powerful electric windlass on the forecastle deck. The electric steering-gear is a Brown Bros. Welin davits of the latest type carry the life boats. Excellent quarters have been arranged for the officers and crew, all these being amidships in a special deckhouse. On the shelter deck there is a large saloon and the owner's quarters.

For the purpose of comparison we reproduce herewith the figures previously given regarding the steamship HIBERNIA side by side with the preliminary figures of the motorship ERLAND:

	Swedish Lloyds Steamer "Hibernia."	Tirfing Company's Motorship "Erland."
Deadweight-capacity	3,750 tons	3,750 tons
Net cargo-capacity on round transatlantic voyage	3,000 tons	3,425 tons
Cubic capacity (bales)	Not available	165,250 cu. ft.
do (grain)	Not available	199,255 cu. ft.
Length O. A.	302′ 10″	302′ 10″
Length B. P.	292′	292′
Breadth M. D.	43′	43′
Depth M. D.	19′	19′
Depth to S. D.	26′	26′
Draught	19′ 9¼	...
Power (indicated)	1,300 h.p.	1,600 h.p.
Power (effective)	1,150 h.p.	1,200 h.p.
Engine speed	......	95 r.p.m.
Ship's speed loaded	10½ knots	10½ knots
Daily fuel-consumption	22 tons (coal)	5½ tons (oil)
Bunker-capacity	605 tons	481 tons
Fuel required on round transatlantic voyage (incl. port)	555 tons	185 tons
Cruising radius	6,700 nau. miles	7,200 to 25,000 nau. miles
Length of machinery space and cross bunkers	62′ 3″	42′

It is very interesting to see how these figures work out in service. The HIBERNIA, of course, has been in operation for some years, whereas the ERLAND left immediately following the trials on a voyage to the Mediterranean and Black Sea. It will be noted that we have given the speed of the motorship loaded as 10½ knots, but it is possible she will do better in service as the four trials with the vessel light showed a speed of slightly over 12½ knots. Unquestionably she will maintain a better average sea speed than the steamer because her propeller revolutions will be more even. We again draw attention to the fact that there is a gain of 20 ft. 3 in. length of cargo space in the widest part of the ship due to the installation of Diesel power.



Engine-room plan of motorship "Erland"

NEW WORK BOATS FOR PORT OF PORTLAND

Bids on three Diesel-engine installations for the Port of Portland were opened on October 2nd. The new constructions in question are a pilot-boat, a dredge tender and the installation of a Diesel engine in a dredge tender now operated by steam. Bids were opened at the office of David Dickie, Naval Architect, San Francisco, by James H. Polhemus, general manager of the Port (which controls the water front of Portland, Oregon) and were taken back to Portland for approval by the Board.

When built the pilot-boat will lie at anchor on the bar off the mouth of the Columbia River and will proceed to Astoria every ten days for supplies and storage. She will have a 165 b.h.p. oil-engine and will be similar to the GRACIE S., the Bolinder-engined pilot-boat operating outside the Golden Cage. Her dimensions are to be as follows:

Length	120′
Breadth	26′ 8″
Draft	11′
Depth	14′ 3″
Length of engine-room	18′

The hull will be of cedar frames with pine planking and will be built at the Port of Portland's shipyard under the supervision of Mr. Polhemus.

"FORDONIAN" NOW OPERATES ON GT. LAKES

FORDONIAN, the Todd-converted motorship, recently arrived at Chicago, Ill., being engaged in the Great Lakes service. It will be remembered this Diesel-electric vessel is propelled by Ansaldo-San Georgio-General Electric equipment with Venn-Severin auxiliary oil-engines. At the present time the FORDONIAN is the only motorship on the Great Lakes, and should do much to convert local shipowners to belief in the economy of motor power.

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Cargo Carriers of the Future

A Discussion on Existing and Forthcoming Types of Propelling and Auxiliary Machinery for Freighters

By JAMES RICHARDSON, B.Sc.

AT no time in the history of marine propulsion have so many types of propelling machinery been available to the shipowner from which to choose. Nor is the problem of selection a matter of easy solution. Not only is the propelling and deck machinery of great importance as regards first cost, but the economy and certainty of operation of this propelling machinery is a dominant factor in governing the margin between profit and loss. Shipowners of the sea-going nations of the world are now faced with the necessity of increasing tonnage although the total tonnage today available is generally in excess, certain classes being excepted, of the freight-carrying demands, yet the figures which have recently and frequently been produced are misleading if taken at their face value. The latest official returns show that of all the vessels owned in the world 31.5 per cent. are over 20 years old and more than 20 per cent. are over 25 years old. All these factors can only lead to the definite conclusion that there certainly must be a considerable amount of building of new tonnage in the near future. The question, therefore, of the type of ship, as denoted by propelling machinery, naturally arises, and in this connection a decision must be made regarding the fuel to be used, whether oil or coal.

Recently a number of tests ashore, followed up by actual trials under normal operating conditions at sea, have proved that the Diesel oil engine is not so sensitive to burning qualities of fuel oil, including high asphaltic bunker oils, as was earlier believed to be the case. As to whether the extra overhauling, which the heavier and less easily combustible oils may well demand, counterbalances the savings in fuel costs, will emerge in time, but it is certain that the capacity to burn reasonably satisfactorily almost any grade of fuel oil in the market is unquestionably an added asset of considerable value and will in the future be regarded as a necessity for ocean-going tramps. Under such conditions as the foregoing, undoubtedly the Diesel oil engine as the most economical consumer of liquid fuel makes a most compelling appeal, requiring only from one-third to one-fifth the quantity of fuel used by equally powerful steamers.

The present position of the Diesel engine is gradually but surely strengthening. There are now available more types of marine propelling plant of all kinds, and particularly of Diesel engines, than ever previously. Hitherto a reasonably full measure of success has been limited to those types of internal-combustion machinery where conservatism in design and construction has been the keynote, but today newer development on a bolder scale in internal combustion are gradually proving themselves at sea. The Diesel engine recently has been thrown further into very strong relief by the troubles which have been experienced with double-reduction gearing.

The maximum powers for which the Diesel engine can definitely be stated to be suitable are gradually increasing, and today 300 b.h.p. per cylinder, with 16 cylinders, *i.e.*, two engines each of eight cylinders, a total of 4,800 shaft h.p., or the equivalent of 5,500 steam indicated horsepower total, is the standard for the large class of motor vessel. This range of power covers 96 per cent. in numbers and 88 per cent. in tonnage of ships under construction at the present time, and whilst making all allowances for the fact that the average today may give a smaller ship than normal, due to the limited number of large liners under construction, yet it is seen that the field already covered as regards power is very considerable.

The largest cylinder at sea still remains 700 b.h.p., but with the particular construction in this case of opposed pistons, the number of cylinders is limited to four. The time is not far distant when Diesel engines of 400 to 500 b.h.p. per cylinder, of various types and in numbers, will be operating at sea with success.

[Two American motorships in service have cylinders of about 500 b.h.p. output.—Editor.]

The Diesel engine still remains a massive and somewhat complicated power plant, and no movement towards simplification has yet definitely set in. Undoubtedly, when shipowners and their superintendents have come to appreciate the principles of operation of this prime mover, a number of so-called "gadgets" at present introduced as safeguards, and in order to make assurance doubly sure, will be discarded. Only in this way does it seem possible definitely to attain greater simplicity. As regards reducing the mass of the engine, there are only two ways in which this can be achieved, either by increasing the mean effective pressure in the cylinders or the piston speed. The governing factor in the design of all internal-combustion engines is the heat flow factor. The greater the cylinder dimensions, the more vital is this consideration. This factor, expressed in pounds of fuel consumed per sq. in. of combustion volumes surface per unit of time, is directly dependent upon the piston speed and, for a constant factor of heat flow, the lower the piston speed the higher the mean effective pressure possible. The converse is true.

> This Treatise is an abstract from a Paper read before the Engineering Section of the British Association on Sept. 12. Mr. Richardson is one of the most practical authorities on Diesel-engine construction in Great Britain to-day. He holds the position of head of the Diesel marine engine department of the well-known Scottish shipbuilding firm, Wm. Beardmore & Co. Very serious considerations to many of his suggestions could be given by shipowners with advantage. Like other oil-engine advocates Mr. Richardson is a steam engineer converted to Diesel power by reason of his first-hand experiences. Limited space in this issue prevents our reproducing this valuable Paper in full.

The tendency for some years past has been to reduce this heat flow factor with increasing size, but the gradual improvements in materials and designs which have permitted of increasing size, as already stated, now allow augmented heat flow, by increasing the mean effective pressure in the cylinders and the piston speed.

The piston speed with a single acting internal-combustion engine can well be higher than with steam practice because of two considerations—firstly, that the maximum pressure for which bearing surfaces are designed is only maintained for approximately 12½ per cent. in the case of four-stroke engines and 25 per cent. of the cycle for two-stroke engines, and secondly, because the pressures on the bearing surfaces are not generally reversed as with double-acting steam engines. The inclination, therefore, especially with four-cycle machinery is to increase the piston speed. With twin-screw ships of relatively high speed, revolutions higher than is usual with steam machinery can be adopted without impairing to any serious extent the overall propulsive efficiency. With single-screw vessels, especially of low speed, the propeller speed must be kept low, and long stroke engines will increasingly be adopted to attain a high piston-speed and good propeller efficiency.

One point that is not perhaps sufficiently emphasized, is, that with Diesel machinery, the higher the power per cylinder, the greater the weight per horsepower, so that for a given power of ship, there is a definite saving in machinery weights when twin-screw engines are adopted in comparison with single-screw machinery. This saving in weight means a certain reduction in cost, although the lesser machinery cost is balanced by the increased cost of hull, due to the extra bossing of the stern and the two tunnels for the two lines of shafting. The chief advantage of single-screw machinery lies in the reduction in personnel which is possible, as obviously an increased engine-room complement is required to superintend and to manœuvre two engines. Nevertheless, for powers above 2,000 to 3,000 shaft h.p., twin-screw Diesel engines will be the rule for some time to come and are to be advocated.

The saving in fuel costs with Diesel machinery must be considered in conjunction with the lubricating-oil consumption, which is higher than with steam machinery. The consumption of lubricating oil has been reduced to a figure of relatively small importance. 1.5 gallons of lubricating oil for all purposes per ton of fuel-oil consumed should be the relation, and has been attained.

Every ship can virtually be regarded as a floating community, and the propelling machinery is not by any means the only consideration. There are the various services, bilge and ballast, heating of cabins and the machinery for handling the ship, the capstan, and the steering gear and for cargo manipulation, the winches. How shall the auxiliaries be driven? So far as steering gear is concerned the electric-hydraulic system has proved itself efficient and is finding increasing favor even on steamships. For lights, fans, electricity is also required. For the heating of a ship, steam is still the most convenient and the least costly method, although either exhaust raised steam at sea and some combination of electrically generated heat and hot water pipes will no doubt find increasing favor.

Therefore for the remainder of the plant, such as winches and pumps, the choice lies between steam or electric drive. Where first cost is concerned, considerable advantage lies on the side of steam, but the more elegant solution and the more economical, from the point of fuel consumption, is undoubtedly the electric drive. Electric current is generated by Diesel-driven dynamos, which, except in very special cases, should not be less in number than three. For reasons of interchangeability these three should be of the same size. One should be sufficient for normal sailing at sea, two are required for manoeuvring the ship or for working cargo in port, and one is

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always a stand-by. The consumption of fuel for working cargo and pumps in port with banked fires in a steamship is of the order of ten times the amount of fuel required by the Diesel-electric system of auxiliary working on similar motorships.

When 2-cycle machinery is adopted the practice of driving the scavenging pumps separately from the main engine to permit of rotary machines being used for this duty will undoubtedly gain favor, and in this case the Diesel-driven generators for supplying electric current for general duties, as well as for driving these blowers, become of very considerable size.

Such figures lead naturally to a consideration as to whether the correct angle from which to review and attack the problem is not to regard the machinery of the ship as a central electric power-station delivering current to electric motors for propulsion and all the other multifarious duties. For special purpose ships, where the duties apart from propulsion require a substantial measure of the total power as, for instance, dredgers, ferry-boats, cable-ships, etc., the Diesel-electric system is being adopted and merits the closest attention. It is favored in America and has been regarded also, by virtue of the great subdivision possible, as a means of adopting the Diesel principle to ships of the highest power. It is heavy, the first cost is high, and electric machinery suitable for marine work requires a certain amount of development before it will prove quite as reliable as the remainder of the installation.

The three factors of first cost, personnel and upkeep are still regarded, in some quarters, as deterrents to the motorship. The first cost for similar sized steamers and motorships is in favor of the former. This is the general comparison made, although it is false. A smaller motorship will suffice because of the saving of space due to the type of machinery, principally in bunkers, in increased radius of action per ton of fuel and decreased personnel.

In inviting tenders shipowners would be well advised in order that they may accurately assess the position of the motorship to state simply the duty of the ship and the sea speed required, leaving the contracting naval architect and marine engineer to decide the best combinations of features to meet the requiremnts at the minimum first cost. Such are the advantages of the motorship, especially on certain and many important trade routes, that any extra first cost is quickly written off.

When next marine construction is energetically pursued, as undoubtedly it must be, the motorship will be in the forefront. To-day at sea the tonnage of motorships is 6.5 times what it amounted to in 1914, and of the present total, more than one-half, or 848,000 tons, represents 149 vessels of over 3,000 tons. Of ships under construction at the present time those to be engined with internal-combustion machinery form such a proportion as to make the future for this new type appear extremely bright.

* * *

A discussion followed the reading of Mr. Richardson's interesting paper participated in by Professors G. G. Stoney, F. C. Lea, G. W. O. Howe, and Hodson-Beare, and by Mr. J. V. Coonan. Professor Stoney expressed the opinion that electrically-driven auxiliaries should be used to a much larger extent at sea than they were, because steam-driven auxiliaries were most extravagant. To a certain extent, the heat could be recovered by feed heaters, but only to a moderate extent. In many cases, the amount of auxiliary steam was much greater than that absorbed by feed heaters, and, therefore, more economical engines were required. For this reason, he believed there would be a very large development of electrically-driven auxiliaries, not only in Diesel ships, but also in some steam-driven ships. In that case, he would expect Diesel-electric plants to be the best.

Our Readers' Opinion

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed.)

ANOTHER TAMADA DIESEL ENGINE

To the Editor of Motorship:

Some time ago I sent you photographs of two Diesel marine-engines built by me, and which you published. I have now constructed another Diesel engine. It is of the two-cycle type, with two cylinders, 10¼" bore by 12" stroke, turning at 360 r.p.m. and driving a 42" x 42" propeller. Scavenging air is compressed in each section of the crankcase and there is a super-charge of air from scavenging cylinders. The injection-air compressor is arranged in tandem on the scavenging cylinder. For the injection-valve itself I have patented an atomizer. An illustration of this engine is attached herewith.

T. Tamada.

Tokyo, Japan.

THE MARINE EXHIBITION

Among the many interesting exhibits applicable to motor-vessels which will be exhibited at the forthcoming Second Marine Exposition at the Grand Central Palace November 4th to 11th, will be a miniature Diesel-electric propelling equipment, which model was built entirely by members of the Marine Sales Department of the Westinghouse Electric & Manufacturing Company, for the purpose of demonstrating the extreme flexibility which may be obtained with Diesel-electric drive for marine purposes. The unit is approximately one-eighth the size of a 1,500 h.p. propelling equipment and is mounted upon a base of 5 ft. x 9 ft. It consists of two engine-driven generating units, each with exciter, the generators in turn supplying power to the single propelling-motor. The motor drives a propeller enclosed in a glass case.

In addition the Westinghouse Company will exhibit a watertight deck-winch motor and control, which is the same special design of motor and control that gave such splendid performance on the motorships California and William Penn.

Another interesting exhibit at the show will be the new Mechanical Quartermaster, or Automatic Helmsman, designed and built by the Sperry-Gyroscope Company. This will be shown at the booth of the Sperry Company and is described and illustrated on another page in this issue.

The General Electric Company will exhibit at the forthcoming Marine Show with a large number of the Company's products that are of special interest to marine engineers, shipbuilders, etc. These will include the rotating element of a 3,000 h.p. reduction gear, a model of the low speed gear and actual spring thrust bearing, also ships' auxiliary apparatus. Of special interest to "Motorship" readers will be the control panels built for the Diesel-electric Golden-Gate Ferries.

REAR-ADMIRAL TAYLOR JOINS SHIPPING COMPANY

The American Ship and Commerce Corp. of New York announces that Rear Admiral D. W. Taylor has been engaged by them as Consulting-expert in all questions of ship design, construction and operation of economics. Admiral Taylor is recognized as an international authority on the subject and until recently was chief-constructor of the U. S. Navy, as well as chief of the Departments of the Bureau of Construction and Repair.

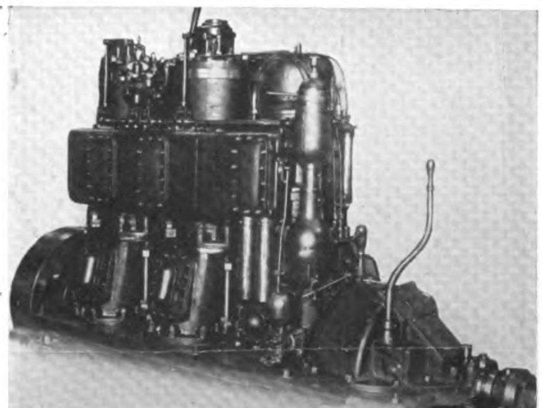
NORSKE VERITAS REPORT

The Norske Veritas, which surveys the mercantile fleets of the Scandinavian countries, has issued its annual report for 1921.

In Denmark in 1921 nine motorships of 27,132 tons were built in Danish yards, seven being of steel, one of concrete and one of wood construction. Four motorships and one auxiliary were built outside of Denmark for Danish owners.

In Norway during 1921 there were 34,000 tons of new motorships, which tonnage included three new motorships built in Denmark for Norwegian owners. Five old motorships were purchased abroad.

In Sweden during 1921, 40,000 tons of new motorships were added, one having been built in Denmark, which also supplied Diesel engines for one new motorship built in Sweden.



The third Tamada Diesel marine engine

"Ginger Dot," the new Mianus oil-engined yacht of F. B. Stearns built by Luders of Stamford, Conn.

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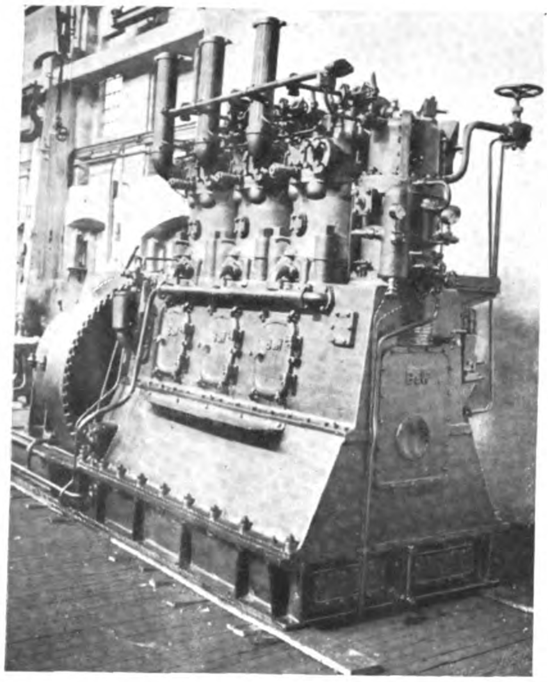


One of the B. & W. auxiliary Diesel-electric sets

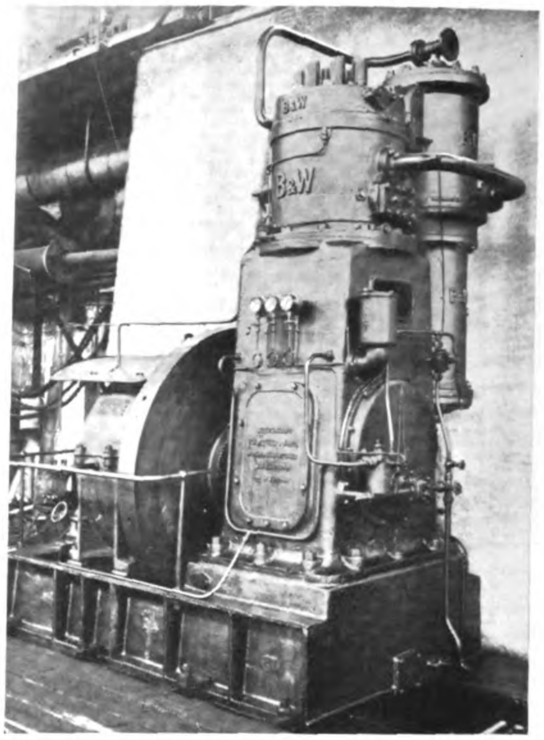
TWIN-SCREW 6,000 I.H.P. MACHINERY FOR OCEAN STEAMSHIP COMPANY'S MOTORSHIP

Recently there was constructed at the Burmeister & Wain plant in Denmark, a pair of high-powered Diesel-engines for a Diesel-driven cargo liner completing in Scotland for the Ocean Steamship Company of Liverpool. Two units form the propelling plant and there are four auxiliary Diesel-engines connected to generators for the purpose of providing power for all the engine-room and deck equipment.

The propelling engines both have eight cylinders 740 mm. (29.1339") bore by 1150 mm. (45.2759") stroke, and each has a continuous output at normal sea load of 3,000 i.h.p. at 115 r.p.m., making a total of 6,000 i.h.p. for propelling purposes. These engines are of the single-acting, four-cycle, crosshead type, are direct reversible, and have forced lubrication. At the forward end of each engine there is a multi-stage air-compressor capable of furnishing all the necessary high-pressure injection-air while the engines are in operation. Each of these engines is 39'5" long and weigh 365 metric tons. Every cylinder has a separate fuel-oil pump, in accordance with the practice most widely adopted by Diesel manufacturers.

In addition to the regular cargo the ship will carry passengers and will have a large refrigerating plant. Consequently, a considerable amount of electrical power is required; so there are four auxiliary engines each developing 150 b.h.p. at 300 revolutions per minute and direct connected to a 100 K.W. 220 volt generator. All these engines have their own multi-stage air-compressor for injection-air purposes.

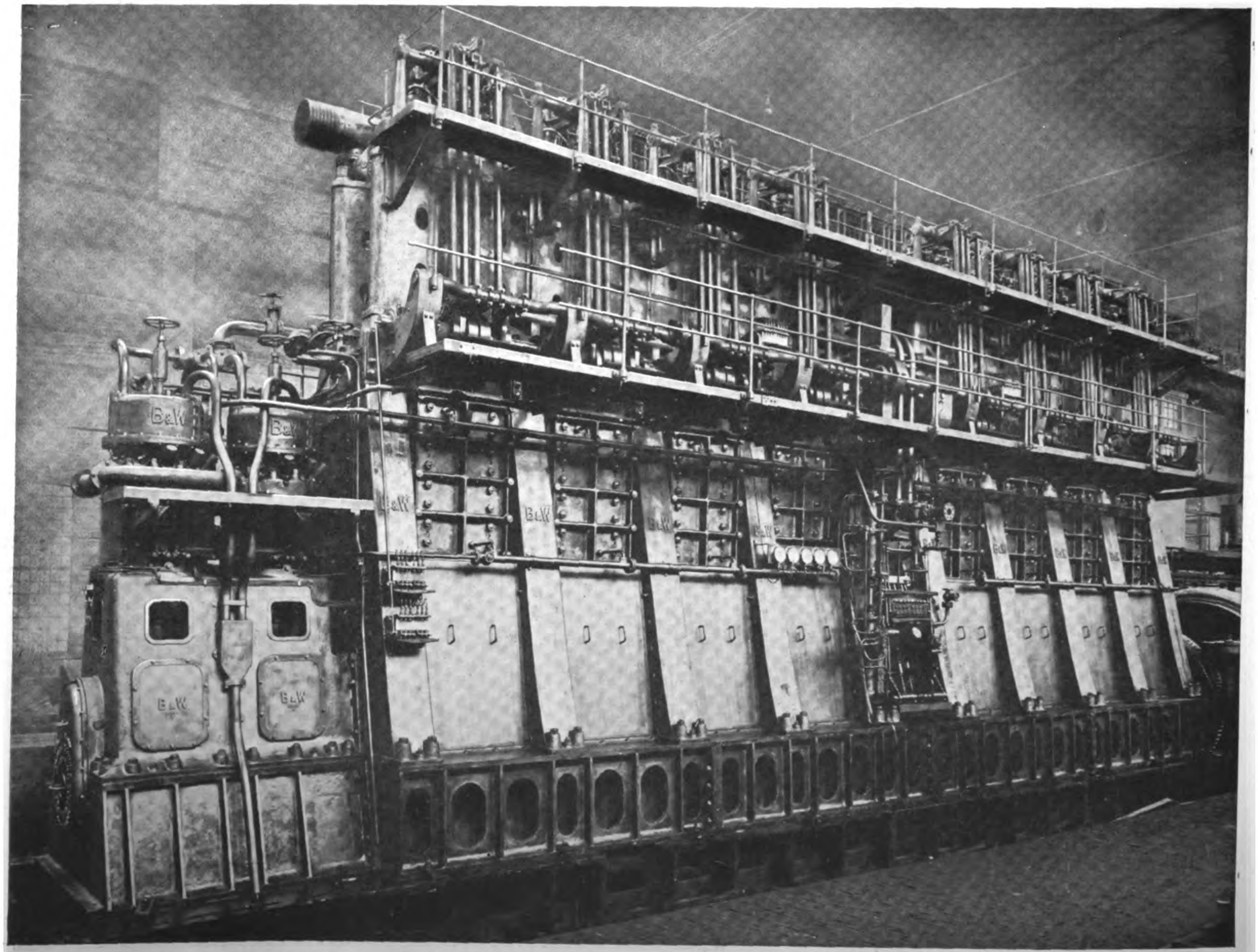
Manoeuvering air for starting and reversing the main engines and for starting the auxiliary air-compressors are driven by an electric motor. This particular compressor, of which we also give an illustration, is of the multi-stage type compressing up to 355 pounds per square inch. All the auxiliary engine-room machinery is electrically-driven and includes two cooling-water pumps, two lubricating-oil pumps, one daily supply and transfer pump. In addition there is a small steam-driven emergency air-compressor that obtains its steam from a small donkey-boiler installed for heating the ship.



Auxiliary air-compressor of the Ocean S.S. Co.'s motorship

A HUGE OIL ENGINE BUSINESS

We have before us a complete list of 234 Pacific Coast heavy oil-engine installations carried-out in work-boats by the Fairbanks-Morse Company, ranging from 30 to 200 h.p.



One of the twin 3,000 i.h.p. Burmeister & Wain Diesel engines of the Ocean Steamship Company's new motorship "Ocean I"

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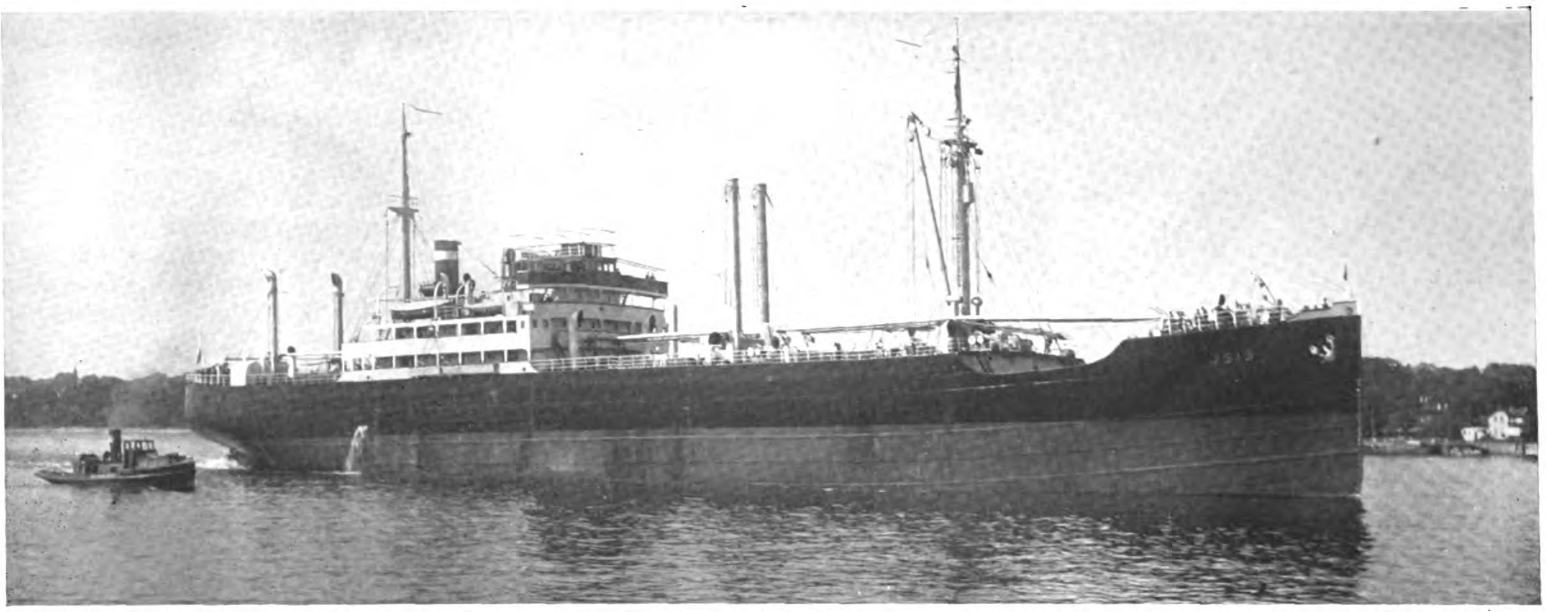


New German motorship "Isis," built by the Deutsche Werft

First German Built Twin-Screw B. & W. Motorships

Kosmos Line Motorships "Isis" and "Osiris," Built by Deutsche Werft

By ERIK HILDESHEIM

FOLLOWING closely upon the completion of the two single-screw 4,000 tons Diesel-tankers JULIUS SCHINDLER and OSSAG, the Deutsche Werft at Hamburg, Germany, specializing in motorships, has now delivered the first vessel of a larger type and the second is nearing completion, these being the ISIS and OSIRIS. They are sister ships, built to the order of the Kosmos Line, this Hamburg shipping company having joined the long list of Diesel-ship operators. They will be operated in the South American West Coast trade, one of the routes offering greatest opportunity for motorships.

As briefly reported last month, the ISIS ran successful trials and proceeded on her maiden voyage. She is of the following dimensions:

Length overall	392′ 9⅞″
Length between b.p.	375′ 0″
Breadth, extreme	51′ 6⅛″
Depth to main deck	28′ 3¾″
Depth to poop deck	36′ 9¾″
Maximum draught (loaded)	24′ 0⅜″
Speed	12 knots
Total cubic capacity of holds	339,525 cu. ft. (grain)
Gross tonnage	4,454 reg. tons
Net tonnage	2,618 reg. tons
Below deck tonnage	3,883 reg. tons

She is rigged with two masts and is built with a cruiser stern. The engine installation is arranged well aft with cargo holds both forward and aft of this space. The total capacity of these cargo holds is 399,535 cu. ft. of grain or 360,976 cu. ft. bales. In the double bottom 950 tons of fuel-oil are carried and there are two daily-service tanks in the engine-room together holding about 2500 gals. Providing access to the cargo holds are three hatches 36′ 9″ x 17′ and one hatch 28′ 1″ x 17′, these being served by twelve electric deck winches and 3, 5, and 40 tons' capacity derricks. The engineer's and petty officers' quarters are arranged around the engine casing.

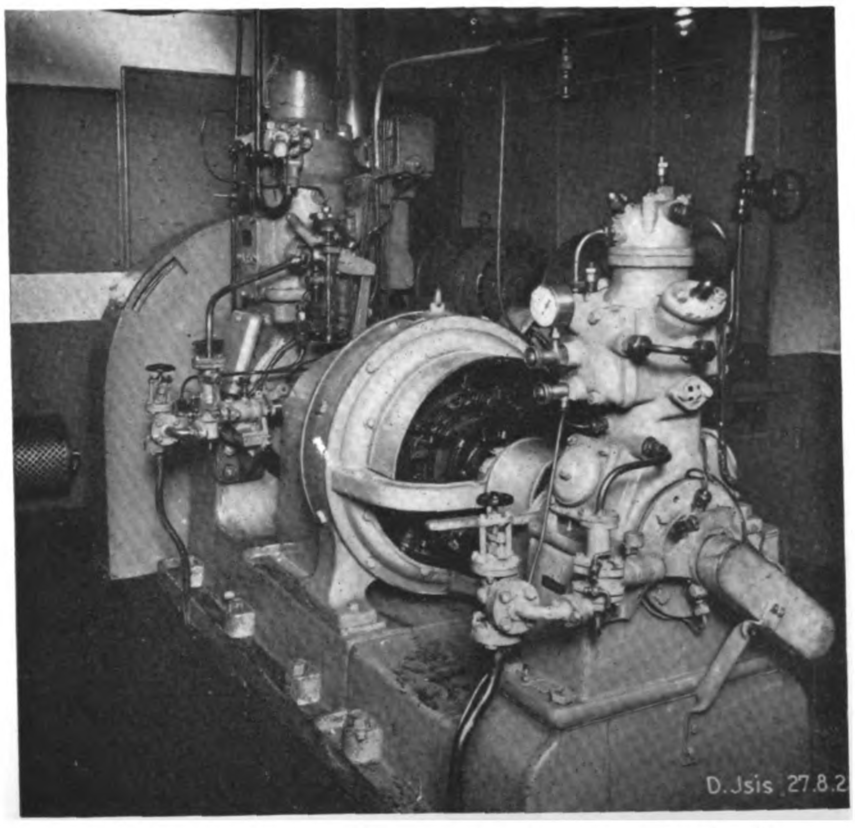
There are two six-cylinder, four-cycle single-acting A. E. G. Burmeister & Wain Diesel engines of 630 mm. (24.803″) bore, and 960 mm. (37.795″) stroke, each developing 1,550 i.h.p. at 125 r.p.m. The propellers, having bronze blades and cast-iron hub, are 3.5 m. (11′-5″) diameter and 3.36 m (11′-2″) pitch. During the trial trip the total fuel consumption, including the auxiliaries, amounted to 147.5 grams (0.324 lb.) per i.h.p. hour. The auxiliary equipment is exceptionally complete, electric-driven pumps being supplied.

"HANDICAP" LEAVES FULLY LOADED

On Sept. 16th the Sulzer engined motorship HANDICAP arrived at San Francisco from Yokohama, having left the latter port on August 27th. She sailed again from San Francisco on Oct. 2nd, having secured a full cargo for London and will probably proceed directly across the Atlantic, from the Panama Canal, although originally scheduled to stop at eastern ports.

BOLINDER ENGINES FOR TUGS

The Carey-Davis Tow Boat Co., of Seattle, Wash., has purchased two 320 h.p. Bolinder-engines from the Shipping Board and will install them in steam tugs. They are converting their fleet to oil-engine power.



Auxiliary Diesel generating and compressor set of the "Isis"

Engine room of the "Isis," showing controls

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Transmission for Diesel Oil Engines

Suggested Use of the Föttinger Transformer

By A. C. HOLZAPFEL

THE present cost of reversible Diesel oil engines of the marine type is very considerable, so much so that some proposals have recently been made to use electrical transmission with this type of engine. With electrical or other suitable transmission a much lighter, non-reversible Diesel engine of high revolutions could be used, reducing the prime cost of the engine, as well as its weight almost sufficiently to pay for the extra cost and to allow for the extra weight of electrical transmission.

Electrical transmission in connection with turbines is familiar in this country, but there is another method of transmission which so far has not been tried in the United States and that is the Hydraulic Transmission of Prof. Föttinger of the Technical High School of Danzig, and a former employee of the Vulcan Company of Stettin. This transmission consists of a centrifugal pump delivering water into a water turbine, and strange to say, certain natural laws which have been assumed to exist in connection with such machinery so far as loss of power by transmission is concerned, have been disproved by this transmission system which is called in Europe the Föttinger Transformer. The weight of the installation is very moderate, and the loss of power in suitable proportion of prime mover to propeller shaft has been down to 8 per cent, that is much lower than would be possible in connection with electrical transmission. Moreover, the prime cost is considerably less than that of electrical transmission, and there is absolutely no danger such as may result from defective insulation or other causes in connection with electric power.

The Föttinger Transformer was first brought out in connection with a tugboat built by the Vulcan Company on which it gave results corresponding with the anticipations of the builders. The next trial was on a small gas-driven cargo vessel under the British flag where also after one or two adjustments it worked without a hitch. Following this it was applied to a high speed turbine of 5,000 horsepower on a small passenger steamer running between Hamburg and Heligoland. This vessel, at the beginning of the war, was taken over by the German Government and used as a mine layer and she was sunk while depositing mines off the British coast. At that time larger installations were in contemplation. Anyway, the apparatus is one which is exceedingly handy, supplanting the reversing gear and regulating speed down to a single revolution by the moving of a lever. So far it does not seem to have aroused the attention of American engineers, but the time has come when this form of transmission should be studied in connection with high speed oil engines, as it is particularly suitable in the relation of three to six revolutions of the prime mover to one of the propeller shaft, and would therefore enable the use of a light, non-reversible Diesel engine of 400 to 600 revolutions to be reduced to say 100 revolutions on the propeller shaft with a minimum of cost and weight and a maximum of efficiency.

OPPOSED-PISTON ENGINED MOTORSHIP "DOMINION MILLER"

Visit to Furness Withy's Doxford-Built Freighter at Philadelphia

WHEN we recently were aboard the British motorship DOMINION MILLER at Philadelphia, Pa., she was engaged unloading a cargo of 8,500 tons of coal which she had brought from Immingham, England, at an average speed of 10.6 knots in bad weather. This is her third voyage, the first trip having been from England to Las Palmas, Jacksonville, Savannah, Bremerhaven, Hamburg and Southampton, averaging 11.2 knots on 10.4 tons of oil-fuel.

Her second voyage was from Southampton to Savannah, Galveston, Jacksonville, Bremerhaven and Immingham, which she covered at an average speed of 12.25 knots. This makes a total distance of 23,416 nautical-miles, during which period the aggregate stops of her four-cylinder single-screw Doxford Diesel-engine have been less than six hours.

The DOMINION MILLER is owned by Furness Withy & Co. and has previously been described and illustrated in MOTORSHIP. She is in command of Captain G. W. Newman, with H. S. Reavley as first officer. W. Collier is chief engineer. Her total crew consists of 39 officers, engineers, and men. In the engine-room there are eleven men, namely, chief and four assistant-engineers, three oilers, two daymen, or cleaners, and one donkeyman. The ship needs no tugs in port and turns round in her own length. From "half-ahead" to "half-astern" the engine can be reversed in four seconds, which is much quicker than steam.

Generally speaking the main engine averages 3,200 i.h.p at 77 r.p.m. on a consumption of 11 tons of oil at sea. In port the donkey-boiler uses two tons of oil per day, all her deck machinery being steam driven, which we consider a great error. Also the presence of the donkey-boiler in the engine-room makes the latter compartment unbearably hot when the vessel is in port. Consumption of lubricating-oil daily is seven gallons for the cylinders and ten gallons for the other parts and auxiliary plant. The fuel used is of 23 degrees Baumé. Up to the present the vessel has not used heavier boiler-oil except for a short period. Injection pressure now used is 7,500 lbs. per square inch. We presume that as oils of this gravity as well as lighter Diesel oils are only a few cents higher per barrel at the present time the extra bother of running on the heaviest oils is not worth while because of the very small daily consumption compared with a steamship. On the second voyage Persian oil was bunkered.

THE RED D. LINE MOTORSHIPS

As we close for press we have been advised by the Red D. Line that no decision has been made regarding the contract for the two combination passenger and cargo vessels on which they recently opened bids. Both Diesel-drive and steam were called for, McIntosh & Seymour Diesel engines being specified.

The vessels have the following dimensions:

d.w.c.	3,100 tons (long)
Length	320'
Breadth	48'
Loaded Draft	18'
Sea Speed	12-12½ knots
First-Class passengers	54
Second-Class passengers	28
Crew	69

The vessels will be built to the American Bureau of Shipping rules and will be of the twin-screw shelter-deck type, and will be similar to their steamer ZULIA. Theo. Ferris is the designer.

Tenders are being received for the completion of three 385' steamer hulls, two for conversion to Diesel power and one finished as a steamship by Whittelsey & Whittelsey of New York. These hulls were built at Pascagoula, by the International Shipbuilding Co.

The Tebo Basin of the Todd Shipyards Corp. bid $56,860 for the conversion of the Munson Line steamer COVEDALE to McIntosh & Seymour Diesel power. COURTOIS, the sister vessel of the COVEDALE, was recently converted at the Sun Shipyard, Chester, and renamed MUNMOTOR.

In the two 7,500 ton tankers to be converted from gear turbine drive to Diesel power from plans by George C. Sharp of New York, 2,500 shaft h.p. engines will be installed.

The first run of the converted steamer MUNMOTOR ex-COURTOIS was made on Saturday night, Oct. 14th from the Sun Shipyard, Chester, Pa., to Newport News, Va. The run was very successful. She is now propelled by 900 shaft h.p. McIntosh & Seymour Diesel engines.

LARGE PASSENGER-MOTORSHIP ORDERED

As we go to press we are advised of the placing of an important contract, this being for a big Diesel passenger-liner for the Union Steamship Co. of New Zealand, owners of the motorship HAURAKI, who have contracted with the Fairfield Shipbuilding & Engineering Company of Govan, Glasgow, licensees for Sulzer two-cycle oil-engines, for a vessel of the following dimensions:

Length	600'
Breadth	72'
Displacement	22,000 tons
Propulsion	triple-screw
Horsepower	12,000
Type of power	Sulzer Diesel-engines

To those who realize the world's lack of an adequate number of economical passenger-liners, the placing of this order will be significant. Passenger-motorships such as the ABA, have made such a record for economical and reliable operation that there is no doubt that when the record of this new motor passenger-liner has been added to these, increased interest will be taken in the construction of motor passenger-liners.

MOTORSHIPS FOR NAWSCO LINE

In a recent interview with Vice-Pres. M. J. MacDonald of the North Atlantic & Western Steamship Co. (Nawsco Line) he stated that his company now owns two steamers and are operating four other Shipping Board steamships, but that plans are being made to convert six Shipping Board steamers of 10,000 to 12,000 tons d.w.c. to Diesel-drive. Mr. MacDonald lays stress upon the fact that his company believes that in such conversions Diesel engines which can efficiently burn oil such as is used in oil-burning steamers.

Mr. MacDonald recently returned from an extensive trip through Europe in which he particularly investigated Diesel engines and motorships, talking with several leading shipowners and Diesel engine manufacturers in various European countries. We believe that MOTORSHIP will shortly be in a position to publish definite information as to progress.

UNITED FRUIT CO.'S MOTORSHIPS

Two of the United Fruit Co.s Diesel-electric motorships building at Cammell Lairds will be operated by Elders & Fyffers, Ltd., their British subsidiary. The latter concern has also placed an order for a 6,000 tons fruit-carrier with Alex. Stephen & Sons of Glasgow.

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Interesting Notes and News from Everywhere

A SEVENTY ton d.w.c. 50 b.h.p. oil-engined barge can be built in England to-day for $12,000 to $14,500, according to recent figures.

In England a 92 foot by 20 foot trawler has been converted to a motor-yacht to the order of Lord Glentanar. Three Kelvin kerosene engines have been installed.

GOLDEN WEST will be the name of the sister ship to the Werkspoor Diesel-General Electric ferry boat GOLDEN GATE for the Golden Gate Ferry Co. of San Francisco.

One 75 b.h.p. surface-ignition oil-engine constructed by the Anglo-Belgian Co., Ghent, Belgium, is installed in the "INDEPENDENCE," a 104-foot yacht recently built in that country.

A Swedish license for building engines on the Hesselman airless-injection system has been acquired by the Aktiebolaget Bofors, Bofors, Sweden.

MOTORSHIP was recently favored by a visit from Mr. Roland E. Dangerfield, a director of Temple Press, Ltd., London, who is making a short visit in this country.

Will A. K. Utgoff of New York City and Louis Hafner of Long Beach, Cal., please forward their correct addresses because copies of the YEARBOOK forwarded to them have been returned undelivered by the Post Office.

Under construction at James Pollock & Sons Shipyard, Faversham, England, is a 40′ tug equipped with a 30 h.p. Bolinder engine driving hydraulic-propellers constructed on the Hotchkiss principle.

Wm. Beardmore & Co., Ltd., the Scottish shipbuilders and marine Diesel-engine manufacturers, have developed a 1,000 b.h.p. heavy-oil aeroplane engine. Further tests will be run before details will be made public.

Elias Olsen of Floro, Norway, has sold his 571 tons gross motorship, OTEKAST, ex Os, to Danish owners. This vessel is propelled by a 320 b.h.p. Bolinder oil-engine and was built at the Bakkevik Shipyard in 1919.

The new motorship ISIS sailed from Hamburg on her maiden voyage, Sept. 16th, for the West Coast of South America through the Panama Canal. She will devote considerable attention to transporting refrigerated goods.

The Swedish motorship ARATOR, owned by the Swedish Farmers Shipping Co., Ltd., Stockholm, Sweden, and powered with two 750 b.h.p. Burmeister & Wain Diesel engines left Barry, England, September 28th for New York and arrived on Oct. 17th.

In order to keep pace with the business offered in work-boat type marine heavy-oil engines, the Atlas-Imperial Engine Co. of Oakland, Cal., are arranging to run a double shift at their plant and are adding a number of new productive tools.

Another submarine for the U. S. Navy, one of the type of which 30 are being built to be equipped with Diesel engines manufactured by the New London Ship & Engine Co., along slightly varied Nelseco design, recently completed a 100 hr. endurance run at sea. She was built by the Electric Boat Company of Groton, Conn.

Among the motorships which have recently visited New York are the LEIGHTON, LINNELL and LASSELL of the Lamport & Holt line. The latter arrived at New York on her maiden voyage on October 13th. All three motorships are operated in the New York-South American trade.

The U. S. Submarine S-48 recently successfully completed official Government acceptance trials. This submarine was built by the Lake Torpedo Boat Company and is propelled by Busch-Sulzer Diesel-engines and auxiliaries. She is of the very latest and most advanced type of submarine.

Writing on the question of waste heat in Diesel engines, F. Modugno, in a contribution to *Rivista Maritima,* says that the Sperry compound engine is identical, except for a difference in the exhaust-valves, with the Augsburg compound engine tried and rejected in 1896.

Recently the Pacific-Werkspoor Diesel-engined tanker F. H. HARPER had a race from San Pedro to Seattle with the steam-tanker RICHMOND, the crack steam-vessel of the Standard Oil Co. of California's fleet. The HARPER arrived 21½ hours ahead.

Elmer A. Sperry, head of the Sperry-Gyroscope Company is on an interesting visit, both pleasure and official, to Japan. He represents the Society of Naval Architects and Marine Engineers on the occasion of the 25th anniversary of the Society of Naval Architecture of Japan.

There are at present under construction for private owners, as of September 1st, 75 river and harbor steel boats in this country. While this by no means compares with the extremely busy conditions of a few years ago we feel that this is a good showing and indicates considerable activity in the small boat line.

The construction of full-powered motorships during twelve months ending June 30, 1922, increased 30 per cent. as against a gain of 4 per cent. increase in steam tonnage. The order of motorship tonnage is as follows:—United Kingdom, Sweden, Norway and the United States. No information is given regarding increase in motor-work-boat tonnage.

DWARKA, the British India Steam Navigation Co.'s new 2,050 tons passenger-cargo motorship launched at Charles Hill & Son's yard, Bristol, England, on Sept. 8th. Twin North British Diesel-engines are installed. She will carry 44 first and second-class passengers and general freight. Dimensions, 286 feet by 43 feet 6 inches by 24 feet.

The fishing boat CARNEGIE, Capt. Johannsen, recently arrived in New York from Göteborg, Sweden, after a non-stop run of 24 days across the Atlantic. She has a single-cylinder 35 h.p. Avance oil-engine and is equipped with a new type of Danish trawling gear. She will fish for Cheseborough & Robbins of Fulton Fish Market, New York.

It was recently mentioned in MOTORSHIP that the Sun Shipbuilding Co. of Chester, Pa., had submitted the lowest bid for four Diesel-electric sea-going hopper dredges for the War Department out of a list of 16 bidders, including four Navy Yards. The Sun Shipbuilding Company has been officially awarded the contract for the construction of these dredges and the work is proceeding rapidly.

Mr. A. Conti, who formerly was Chief-turbine engineer of the United States Shipping Board, is establishing a consulting-engineering business in the Diesel engineering field. Mr. Conti has just returned from a four months' trip visiting the principal Diesel engine factories in Europe, including Werkspoor, Ansaldo-San Giorgio, Krupps and Sulzer-Frères.

Tankers, Ltd., who recently built four motorships and five steamers aggregating 88,375 tons, all oil carriers, paid £3,861,826 ($16,412,750.50 at current exchange rates of $4.25 to the Pound), or about $190 per ton for the nine ships. Recently we were enabled to see the operating figures based on seven of the fleet in service, and the motorships showed a distinct economy, even allowing for their slightly higher first-cost.

On the first run of the newly completed inspection boat GOVERNOR STEVENS for the San Francisco Harbor Commission, the De Laval oil purifier installed in connection with the 100 h.p. Enterprise Diesel engine removed 0.289 per cent (practically 3-10ths of one per cent) of sludge and grit from the lubricating oil and returned the cleansed oil to the lubricating-oil system. This removal of fine grit and impurities from the lubricating-oil cuts down repair bills and increases the life of the engine.

In a recent issue *Shipping Register* of San Francisco says: "Probably there is no other one phase of the shipping industry so fraught with encouragement and great prospects for the future as that of the Diesel engine, practical demonstration of commercial carriers showing conclusively trip after trip the economies over steam has convinced the more skeptical that the internal-combustion engine is no longer an experiment. Conversion is one of the Diesel phases in activity at present, and it appears that this will be even greater if the ship subsidy is passed."

Partial record of the recent growth of motorship construction may be found from the figures recently issued by the Transportation Division of the U. S. Department of Commerce. Unfortunately it is not so good a guide to domestic progress as it would be if it dealt entirely with American ships instead of with the world's tonnage. Aside from craft over 2,000 tons there are now 605 motor-vessels between 100 and 2,000 tons aggregating just under a quarter million tons, a gain of 52 moderate sized vessels in one year. In seven years 825 motor-auxiliary ships have been built, the United States leading in tonnage. This includes war construction of this type.

The world's largest Diesel-electric plant is now being designed for an important mining concern by the Nordberg Mfg. Co., Milwaukee, Wis., and it is expected that the actual deal to build it will be carried through within a year. There will be five Nordberg-Carels two-cycle Diesel engines connected to generators, and each engine will develop 4,000 brake h.p. at 100 r.p.m. from four cylinders 36″ bore by 60″ stroke, and will weigh 700 tons. It is possible, however, that each engine will have six cylinders and develop 6,000 b.h.p., giving the plant an aggregate of 30,000 horse-power. We were enabled to see the preliminary plans for these big engines, most of the part drawings being completed.

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